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THE AMERICAN TELEPHONE JOURNAL

PUBLISHED EVERY SATURDAY.
TELEPHONY PUBLISHING COMPANY.
VOLUME 70, No. 8.

CHICAGO, FEBRUARY 19, 1916.

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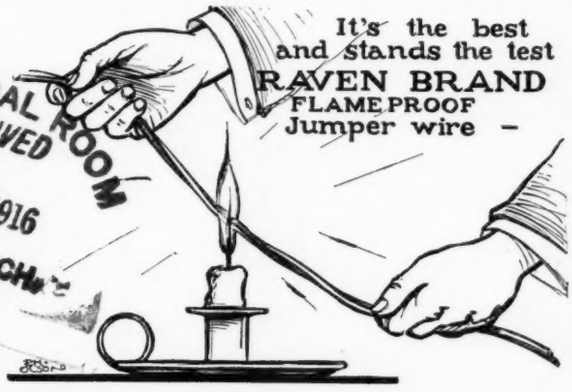

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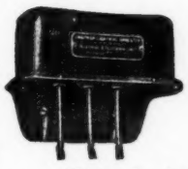

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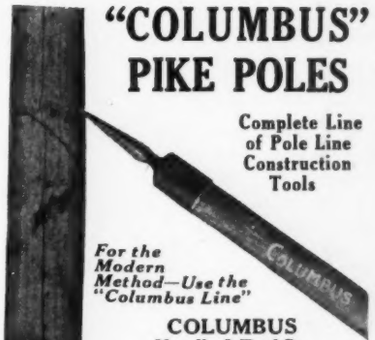

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THE AMERICAN TELEPHONE JOURNAL

Comprising Telephony, American Telephone Journal, Telephone Weekly, Telephone Magazine, Telephone Securities, The Telephone, Sound Waves

PUBLISHED WEEKLY BY THE TELEPHONY PUBLISHING COMPANY
MONADNOCK BLOCK, CHICAGO

H. B. McMEAL, President and Editor. H. D. FARGO, Secretary and Treasurer. J. C. KELSEY, Vice-President and Financial Editor.
S. R. EDWARDS, Managing Editor. J. R. HASTIE, Vice-President and Advertising Manager. W. E. RAYMOND, Subscription Manager.

Entered as second-class matter September 4, 1908, at the post office at Chicago, Ill., under act of March 3, 1897

Volume 70
Number 8

CHICAGO, SATURDAY, FEBRUARY 19, 1916

Subscription—10 Cents a Copy
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THE MEANING OF "SERVICE FIRST."

"Service First" means Greater Service, a Greater Number of Subscribers, Greater Harmony and Co-Operation, as well as Greater Efficiency.

A Job for Washington.

The attention of the Federal Trade Commission, which was established for the purpose of giving all business interests a square deal and eliminating unfair competition, is directed to what took place at the recent convention of the Wisconsin State Telephone Association, a full report of which appears in this issue.

There was a strong representation of enterprising Independent telephone manufacturers and accessory dealers who made their usual fine exhibits. The Western Electric Co., the maker of Bell apparatus, was also on the ground with an exhibit, soliciting business from Independent telephone companies although the Independent manufacturers are debarred from seeking Bell business. It was that very point that led to the incident of which the Federal Trade Commission should take cognizance.

The Independent manufacturing representatives submitted a communication to the convention, pointing out this condition, and urging the Wisconsin association to bar the Western Electric Co. from exhibiting or taking part in its future conventions. Before the question came to a show-down vote, a representative of the Western Electric Co. tendered the resignation of that concern from the association, and cut the knot that threatened to ensnarl things.

The Wisconsin association does not claim to be a distinctively Independent telephone organization. It numbers Bell companies among its members, and, as its name implies, it is a "state telephone association." For that reason, the Western Electric incident is all the more significant.

The protest filed by the Independent manufacturers plainly describes the situation which permits the Bell factory to solicit Independent business while the field of the Bell operating companies remains closed territory. It was the Independent manufacturers who made possible the Independent telephone industry, and gave the people a chance to escape from the Bell monopoly. Meanwhile, the protest declares, the Bell-Western Electric combination resorted to every means to crush the Independents, and recent court trials and investigations show the unfair condition existing. Small wonder, then, that the Independent manufacturers filed their protest at the Madison convention.

Naturally, the Bell members of the Wisconsin association would have been slow in voting to bar out the Bell factory, but it was understood that unless this was done the Independent manufacturers would have withdrawn and declined to exhibit at future conventions. The dilemma was removed when the Western Electric Co. resigned from the association rather than brave the wrath of its opponents.

Much has been heard in the last few years about the Bell being willing to "tote fair" with the Independents. Considerable noise has been made about the "conciliatory attitude" of the Bell and that it was willing to adopt the policy of "live and let live." So long as the Bell-Western Electric situation, which led to the Wisconsin incident, continues, it will be difficult to make this harmony talk stick.

The specter of government ownership, no doubt, has some effect in making the Bell realize that it would be wise to make others in the telephone business believe, at least, that there was a desire for harmony and co-operation. The Bell officials well know that, when it comes to wide political influence, the Independents have a big advantage, for the reason that they are close to the people. Locally-owned telephone companies are responsible for that.

This Bell-Western Electric alliance is one that the federal authorities should act upon, and the Independent manufacturers should be aided in bringing the matter to a speedy settlement. The Wisconsin episode may prove helpful in that direction.

The Bump Academy

By HERBERT KAUFMAN

Your line of talk won a hearing, but your line of goods lost it. We gave you a show, not an annual pass—we presented an opportunity, not a franchise.

Words and work each have their place—conservation is a vehicle for ideas, but we couldn't find any riding in yours.

You were inspected before you were rejected. You bluffed. It didn't go—so you must.

If we are incompetent judges of ability, everybody else isn't a fool, and keener minds will appreciate what we overlooked. But since you have regularly received the same verdict of incapacity, why not begin to wonder if you aren't wrong.

Of course you are sincere—Conceit and you have talked matters over until you are thoroughly convinced of your exceptional talents.

But Vanity always was a liar—if she ever told the truth it would kill her. Your case isn't hopeless—a few more hard kicks may save you. You must be knocked down often enough to learn how poorly you stand. Some of us can't be educated except in the Bump Academy.

You mistake the desire to have for the capacity to hold—confuse ambition with efficiency. And any school that teaches the distinction is worth its cost. We aren't prejudiced against you—only against the things that handicap you. You're green, raw, brash—you leave a bad taste in our experience.

You came to market before ripening into fitness. Mellow, tone down, study yourself, graduate, come back with a better act, and we'll book you. Your critics are not hostile. If you weren't still worth while, nobody would bother to wound and help you.

We intend to cut acquaintance until you mend your ways. Our motives are surgical—we must pain to cure. We want you to suffer—the correction won't count if it can't hurt your pride.

Your best friend has been your worst. When nobody else has a kind word for you, it is time to stop being kind to yourself.

We grant your mettle. There are pay streaks in your mind, but at present they're cheapened by your faults, and worth little until refined.

You're still a good prospect—that's why we all dig at you.

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Convention of Wisconsin State Telephone Association

Seventh Annual Convention Marked by Spirit of Co-operation—Interesting and Instructive Addresses Presented—Transcontinental Telephone Demonstration—Western Electric Co. Withdraws from Membership in Association—Full Report of Proceedings

By Fred L. Holmes

The three-day convention of the Wisconsin State Telephone Association, held in Madison last week, February 9, 10 and 11, was one of the most successful of the seven annual meetings of the association. Plans were laid for increasing the membership of the organization; arrangements were made to bring some of the telephone inequalities before the Wisconsin Railroad Commission for correction; the program was important and the exhibits of the manufacturers, including the first exhibit of the railroad commission, attracted much attention.

The predominating feature of the convention was the spirit of co-operation that prevailed. When the addresses were over, telephone men were to be found in little knots talking over their troubles and gaining the experiences of others as to how many of the difficulties could be avoided.

At the conclusion of the program on Friday evening the directors of the association held a meeting and elected the following officers for the coming year: President, F. H. Runkel, Portage; vice-president, H. H. Christofferson, Colby; secretary, Walter J. Gallon, Sheboygan; and treasurer, W. F. Goodrich, La Crosse.

On Friday morning Mr. Runkel and Dr. Christofferson were elected directors of the association for a period of three years. Friday afternoon the members of the organization witnessed some demonstrations with electric waves at the University of Wisconsin and received the following congratulatory message by wireless from the navy department:

Wisconsin State Telephone Association:
The navy department takes this occasion to express to the Wisconsin State Telephone Association its good wishes and its pleasure in being able to co-operate in a small measure with the telephone men of the United States.
(Signed) Joseph Daniels.

Opening Session.

Following the addresses of welcome by Mayor A. H. Kayser, of the city of Madison, and C. L. Miller, district manager of the Wisconsin Telephone Co., at Madison, and the response by J. C. Crowley, of Superior, the convention got down to business Wednesday afternoon. Its sessions were held in the auditorium of the Park Hotel and the exhibits of the different manufacturing concerns were in separate rooms on the second floor.

President's Annual Address.

President W. L. Smith, of Neillsville, sounded the keynote of the meeting in asking for greater co-operation. He said that by united effort much could be accomplished that would be impossible through the efforts of minority factions. Even though business conditions had been subjected to great fluctuations during the past year, the telephone industry "still maintains itself on an even keel." He complimented the legislative committee of the association for aiding at the last session in securing the passage of a law giving the railroad commission power to supervise the line construction of power and telephone companies.

"My work during the past year has convinced me more thoroughly that the district method of organization is the proper one and I cannot urge you too strongly to give it a trial," declared President Smith. He said that the work of the association had become so heavy that some one person should devote his entire time to it.

"The government ownership idea is still lurking in the political horizon," continued Mr. Smith, "and though it may seem dormant at the time, be assured that those who are in favor of this thing are not inactive, but are spreading their propaganda with all the power at their command. Keep in touch with your congressmen on this subject. Be prepared also to see an attack made on our commission form of government in this state. It may come from unexpected quarters. If it should come we should stand firmly in support of a system that has given our business more stability than any other."

Mr. Smith pointed out that at the convention of the national associations held in Chicago last December the two conflicting factions had harmonized their differences. Independent telephone men should extend aid to the men back of the new association, he urged.

"Methods Employed in the Valuation of Physical Properties," was the subject of an address delivered by C. M. Larson, chief engineer of the Wisconsin Railroad Commission. He outlined the extent of the telephone industry in the state showing that there were about 806 telephone utilities in Wisconsin with over 1,000 exchanges, in addition to the Wisconsin Telephone Co. with 78 exchanges. He said that the railroad commission received reports from 257 of these companies and these show a total pole mileage of 25,000 with a total of about 200,000 telephones. Mr. Larson urged each company to perfect its methods of keeping accounts so that a valuation may be made readily and economically, in case the necessity for a valuation should arise. His paper will be published in full in a future issue of Telephony.

On Wednesday evening the members attending the convention were entertained by a theater party at the Orpheum Theater. The utmost of good feeling and co-operation prevailed.

Second Day's Session.

Thursday's session was opened by a report of the financial condition of the association by Secretary P. J. Weirich, of Monroe. It showed a balance on hand, January 1, 1916, of $738. The amount of receipts for the previous year was $834, the disbursements being $843.

A communication was presented by George H. Crandall, salesman for the Garford Mfg. Co., of Elyria, Ohio, asking the association to take some action which would prevent the Western Electric Co. from exhibiting, or taking a part in the conventions of the association. This communication was signed by representatives of the Kellogg, Stromberg-Carlson, Garford, Cracraft-Leich, Monarch, Automatic, American Electric and other Independent manufacturers and was referred to the committee on resolutions. The communication is as follows:

The Independent telephone manufacturers, believing that there are certain practices being countenanced by the Wisconsin State Telephone Association that are inconsistent and unfair to said Independent telephone manufacturers, earnestly call your attention to some of the things, as follows:

After about 18 years of monopoly, the Bell-Western Electric combination had a development throughout the United States of approximately 325,000 telephones, with thousands of communities without any service or with inadequate service. Many of these communities, realizing something of the benefits of the telephone, wanted service; but in most cases when such requests were made known to Bell-Western Electric officials, they received little or no encouragement and scant consideration.

Failing to get the service from the only known source—the Bell-Western Electric combination—they proposed to organize local companies with local capital and buy their equipment; but, even this was denied them by the Bell-Western Electric. Not a telephone or a pair of cords would they sell. In addition, they were told if they organized, invested their money and attempted to give telephone service, they would be crushed out of existence and would be made to lose every dollar so invested.

With true American spirit many promptly engaged in the telephone business. This created a demand which rapidly spread throughout the country and, of necessity, brought into existence Independent telephone manufacturers. Immediately the Bell-Western Electric combination harassed and annoyed the Independent operating and manufacturing companies in every conceivable manner, even going so far as to burn Independent apparatus at public fires as a warning. Patent litigation was started against both operating and manufacturing companies which threatened their very existence, but by means of associated effort and at great expense the Berliner and other patent cases were won and it was made possible for the Independent companies to remain in the business.

During the years that have since passed, the Independent telephone manufacturers have been an important factor in the growth and development of Independent telephony. Freely and generously have they assisted the several local, state and national Independent telephone associations, in both money and time and effort. Many are the operating companies who were befriended and given long-time credit by the Independent telephone manufacturers when they could not purchase anything from the Bell-Western Electric combination for cash, to say nothing of credit.

The Independent telephone manufacturers, therefore, do not think it fair that the Bell-Western Electric combination, which controls exclusively 60 per cent. of the market, should be extended the privilege of selling its wares to the Independent telephone companies whom it previously tried to exterminate and whom it yet hopes to exterminate, and to whom it is fundamentally opposed at the present time, when the Independent telephone manufacturers are not permitted to sell to the Bell companies. Recent court investigations in the Central Union case, which are matters of record, clearly show the unfair position of the Bell-Western Electric combination in this matter.

Its avowed policy is, "One system, one policy and universal service," which if carried out will mean the extermination of locally-owned telephone companies and Independent telephone manufacturers. Therefore, believing that these conditions are unfair, unjust and un-American, we, the undersigned Independent telephone manufacturers respectfully request and urge the Wisconsin State Telephone Association to take such action at this meeting as may be necessary to eliminate the Bell-Western Electric combination from exhibiting or taking part in future meetings of your association.

F. H. Runkel, of Portage, chairman of the legislative committee of the association, in his report said that many bills affecting telephones were presented at the last session of the legislature. Some of these were undesirable and would have hampered the development of the telephone industry in the state had members of the committee not been present to explain the detrimental effects of such legislation. Mr. Runkel explained that the association was well satisfied with the passage of a law which places the power transmission lines under the control of the railroad commission and gives that body power to order construction in such a manner that close proximity will not hamper the character of the service furnished by telephone companies.

Address of W. S. Vivian.

W. S. Vivian, secretary-treasurer of the United States Independent Telephone Association, urged co-operation among telephone men, stating that there were many problems before the telephone companies that could only be solved successfully by a closer and more effective co-operation. He said that 90 per cent. of the world's trouble is caused by misunderstanding and that only by holding conventions and conferences can these problems be successfully met. As the individual companies are the cause of such gatherings, they receive more knowledge and are bound to be more efficient. Each company owes it to the community which it serves, to see that the telephone-using public understands the problems of the company and that it is in sympathy with these problems.

The best way to get these results is through publicity, such as advertising in the daily papers facts about the company; by having visiting days when the public is invited to visit the exchange and by thoroughly explaining the workings of the organization to the visitors so that they will have a comprehensive idea of the telephone plant, of the duties of the operators, and other employes. He urged that to get visitors to the office invitations, nicely gotten up, should be mailed to each subscriber; that attention to the visiting days could be called by placing advertisements in the papers.

Co-operating with Employes.

The qualifications of courtesy, Mr. Vivian declared, should be developed in every employe, not as of a veneer that could be easily detected, but as a real factor in the service to the community. He further urged a spirit of accommodation be developed in every employe so that their first concern would be to please the subscriber. Each company, he said, owes it to the investors to provide proper plant facilities. The employes might be trained ever so well, but if they were not furnished proper tools, they could not get the best results. He urged that greater attention should be paid to perfecting an efficient organization; that accounting matters should be taken care of along true lines; that methods of handling supplies were of great importance; that work sheets and trouble reports should be thoroughly analyzed to see if proper results are being secured.

Each company owes it to itself, Mr. Vivian stated, to know what other companies are doing; whether or not their operating expenses, percentage of development, net income, etc., compare favorably with other companies. In order that this might be done he urged in addition to attending conventions, where these matters are discussed, that each company should see that its employes receive regularly one or more telephone magazines; that these employes should be gathered in conferences frequently where the workings of the plant and articles appearing in telephone magazines could be discussed and thereby be better understood, resulting in greater efficiency and greater earnings in the operation of the property.

Mr. Vivian said that the companies should give more attention to the surroundings of the employes, as a pleasant environment has a tendency to create pride on the part of the employes in the local company. To this end he declared that each company owed itself and the connecting companies to support in a liberal manner by time and thought and money both the state and national associations. The associations, he said, were performing an invaluable service to the industry. When a committee representing the association appears before a legislative or regulative body representing an organization it usually receives more consideration, attention and better results.

"Co-operation plus knowledge, plus efficiency, equals service," Mr. Vivian concluded. "As Sheldon says, 'He profits most who serves most.'"

An interesting talk was made by F. H. Runkel, of Portage, on the subject of "Placing the Telephone Business before the Public." The tenor of his address was to bring the public into closer touch with the telephone business. He advocated the giving to the newspapers and periodicals everything that might be of interest to the public, suggesting also that at least two days out of each month be set aside as visitors' days, extending a welcome to the telephone users, taking them through the exchanges and explaining the methods of operation.

Collection Methods.

"Uniform Methods of Collection" was discussed by J. C. Crowley, Superior; Howard Teasdale, Sparta; E. J. Kneen, Bangor; Dr. H. H. Christofferson, of Colby, and others. In

general all advocated a system which would allow a discount to the subscriber who paid promptly and what might be termed a "penalty" to delinquents.

At this stage of the proceedings a report of the committee on resolutions was offered. The committee recommended the passage of a resolution "that this association take such action as will bring about the exclusion of any or all Western Electric apparatus at future meetings or conventions of this association."

After discussion, however, at the request of President W. L. Smith, action upon this resolution was deferred until the business session of the association Friday morning.

The Help Question.

W. J. Gallon, of Sheboygan, presented a paper on the "Help Question" that attracted considerable interest. He expressed the opinion that many of the schemes gotten up for purposes of application "are inclined to frighten men and women who might develop into very faithful employes." He said it was important to secure people of honesty, integrity and ability and that the men who make the selections should be men of integrity who have made a careful study of human nature. He spoke at some length of the education of the employes.

"I believe that the telephone business is one of the very few callings that pays its employes during the educational period," said Mr. Gallon. He said that this had established a precedent that is meritorious. He also urged plant meetings and said that where they had been tried by larger organizations, "they have proven very beneficial, indeed."

Mr. Gallon spoke of stimulating interest among the employes. He discussed the bonus system, but reached the conclusion in his address that the greatest "incentive is to make a very careful study and see that the wage schedule is the best it possibly can be made for the employes." He urged cheerful surroundings and said that this played an important part in the contentment of employes. He told his audience that permanency of employment and advancement must be considered as very important features toward successful business attainments. Advancement should be on the basis of merit.

"Lastly, taking care of the employes in old age is of the greatest importance," continued Mr. Gallon. "The pressure of living in these days is such that it is almost impossible for an ordinary man to save enough money to prevent him being an object of charity in old age. Therefore, in my estimation, it behooves any organization that has employed a faithful servant for a considerable length of time to provide in its business transactions a fund to take care of the one who has devoted the best of his life to help in the success of the business.

In Germany the government forces the issue. In England this has been practiced by the larger institutions for a great many years. Big business interests in this country are stepping into line with a system better than those of the older countries."

The necessity of keeping accurate accounts, such as are prescribed by the Wisconsin Railroad Commission for telephone companies, was urged in a short talk by J. M. Storkerson, of La Crosse. He said trial balance was of use to show whether the books balanced or not, but the important factors were the receipts and expenses. He used the balance sheets of a typical telephone company to illustrate his remarks. If the expenses exceed the receipts, one of two things must be done, either increase the receipts or cut the expenses. The receipts and expenses, he declared, must be kept entirely separate from the capital account. In figuring the expenses he told his hearers that allowance must be made for depreciation and profits on the business. He showed how the different items of expense may be allocated to show the cost of each branch of the service.

Banquet.

On Thursday evening the annual banquet of the association was held at the Park Hotel. The principal address was made by President Charles R. Van Hise, of the University of Wisconsin. He took as his topic, "The University and the State." He devoted the burden of his talk to an explanation of the cost of instruction at the university and said that the "wild statements made in the public press that the cost of instruction is $500 a year per student are grotesque." He used charts to show his hearers that the university is run economically, for the benefit of the people and that academic freedom is maintained at the institution.

After the formal program of the evening a number of members of the association were initiated into the newly organized "Secret Order of Telephonus." The following officers presided at this unique and original stunt: Chief operator, J. N. Cadby; supervisor, J. C. Crowley; head lineman, C. L. Miller; copper conductor, F. H. Runkel; inside terminal, W. H. Phelps, and grand custodian of the coin box, Miss Ida Gernetzke.

President W. L. Smith, W. F. Goodrich, E. J. Kneen and others were initiated into the order, each depositing silver and copper into the coin box, taking the pledge of allegiance to the order and receiving the password, grip and "S. O. S." of the order. After voting dividends the meeting of the secret order adjourned. The stunt created much merriment.

Friday Morning Session.

At the opening of the session on Friday morning, Halford Erickson, chairman of the Wisconsin Railroad Commission, presented an exhaustive paper on the "Importance of Costs in Valuations and Rate Making." He said that costs are the most important elements in determining both the fair value of the property and business employed in the service and what constitutes reasonable rates for such service. He declared that the importance of having costs would become all the more important as time goes on. Mr. Erickson's paper will appear, in full, in a later issue.

E. B. Fisher, Grand Rapids, Mich., chairman of the board of directors of the United States Independent Telephone Association, gave a short talk before the convention. He was reminiscent, explaining that he had seen the telephone industry grow from an experimental stage to a public necessity. He said the first pair of telephones introduced west of the Allegheny Mountains was installed at Grand Rapids. He reviewed the history of the Independent associations and said that competition afforded by the Independents had been one of the real factors in securing the wider use of the telephone. He urged all the members to join the national association, declaring that where there is co-operation there is strength.

Mr. Fisher paid a tribute to the work of the Wisconsin commission and to the physical connection law passed by the Wisconsin legislature. He said he was proud of Wisconsin, was born in the state and was glad to see it make the advance which it has. He declared that Wisconsin has solved many of the questions which are still problems in other states.

Rate of Return.

In his address on the subject of "Rate of Return," former Assemblyman E. J. Kneen, of La Crosse county, one of the best known telephone men at the convention, declared that an assured rate of return of 8 per cent. under conditions as they exist in Wisconsin would seem to be fair and reasonable.

"Telephone utilities in this state," said Mr. Kneen, "since the passage of the anti-duplication laws, enjoy a very favored position. It is no longer necessary in Wisconsin to provide a rate of return based in part on the large expenses and possible losses involved in competitive public utility business. The territory of each company is amply protected by law and it necessarily follows that the rate of return may be and should be considerably less than where methods of cut-throat competition exist.

An assured return of 8 per cent. on the investment in telephone property would seem to be fair and reasonable. This return should be computed on the true value of the property

in which allowance is made both for going value and approximately about 7 per cent. as a basis for depreciation. If the utility's earnings are in excess of this, such excess should be promptly used in distributing to all classes of service an improvement of the same, or, if the service is exceptionally adequate, in the lowering of the rates to the basis heretofore indicated."

Mr. Kneen spoke of the lack of definite records that are kept by telephone companies and urged that complete records of all transactions and costs of property be kept up to date so that the officers and directors will have no trouble in determining a reasonable rate of return on the fair value of the property of the plant.

"It is evident that there should be some reasonable recognition of superior management in the interests of economy and efficiency," continued Mr. Kneen. "I do not mean to say that where the service is poor and where the management is wasteful, investment should still be the only controlling factor in the allowance of the rate of return. There should indeed be permitted a more liberal rate of return where the accounts are well kept, the service highly adequate and the management scientific and economical.

I am convinced that if under the conditions existing in this state any effort on the part of telephone owners or telephone properties to secure returns far in excess of those indicated, and especially in cases where anything short of the most adequate and expert service exists, would ultimately result in municipal or government ownership, although it is apparent to all of us that the telephone business, especially for local service, is illy adapted to public ownership, management and control.

Excellence of service, courteous treatment of the public, fair and open financial dealings, and satisfaction with a reasonable and moderate return upon the investment are the safeguards for the continued private ownership and management of telephone properties."

Resignation of Western Electric Co.

At the business session of the association A. Collins, appearing for the Western Electric Co., made a statement regarding the future welfare of the association. He said that the Western Electric Co., recognizing the possibilities of friction in the Wisconsin State Telephone Association and being desirous of promoting a feeling of good-fellowship and co-operation between the different operating companies of the state, voluntarily resigned from the association. This action of course brought to naught the effort of Thursday to bar the company from exhibiting at future meetings of the association. President W. L. Smith in accepting the resignation for the association said that he accepted it "in the spirit in which it has been offered; for the future welfare and permanency of the Wisconsin telephone association."

Two minor changes were made in the by-laws of the association. One provides that the secretary elected need not be a member of the board of directors, and the other resolution specifies that the annual election of the directors shall be held on the second day of the convention and provides for a primary.

Resolutions Adopted.

Three resolutions were presented by the committee on resolutions and unanimously adopted by the association. These resolutions were as follows:

Whereas, there is much loss and expense and unfair discrimination as to credits in the collection of telephone accounts by the methods in use,

Therefore, be it resolved that this association, by its secretary, petition the railroad commission to instruct or order a state-wide advance in telephone rentals of 25 cents per month, which amount shall be deducted for payment of telephone rental during the current month, and that the chair appoint a committee of five, with Senator Teasdale as chairman, to confer with the railroad commission in reference to the same.

Be it resolved that we favor having the railroad commission investigate and order a uniform rate per mile for long distance charges and that the division of tolls be divided on the basis of toll line miles used.

Whereas, it is well known that much dissatisfaction exists over the almost universal commission of 15 per cent. for originating business paid by the Wisconsin Telephone Co., and some other toll line companies.

Therefore, be it resolved that the president of this association appoint a committee of five to take this matter up with the railroad commission with the request that they investigate and call a hearing of the matter with a view of arriving at what is a fair compensation in each case of connecting companies.

E. J. Kneen, of La Crosse, explained that these resolutions merely call for an investigation. It is a question merely of what is right or wrong, he said. With this explanation all of the resolutions were unanimously adopted.

The terms of F. H. Runkel, of Portage, and W. L. Smith, of Neillsville, as directors having expired the association took up the election. A motion to re-elect the two retiring directors was stopped by Mr. Smith, who declined to accept. He explained that he thought the directorships should be passed around in order to get new men and ideas interested in the organization. After this statement the convention elected F. H. Runkel and Dr. H. H. Christofferson, of Colby, as directors.

A rising vote of thanks was extended by the association to retiring President Smith, which he accepted in a jovial speech, saying that he will in the future do all possible to promote the interests of the organization.

The concluding session of the convention was held in the physics lecture room of science hall at the University of Wisconsin. H. N. Tolles spoke on "Keeping Step with the Times." The burden of his talk was greater education for the employes. He said there were four essentials necessary in the education of a person: Ability, reliability, endurance and action. These are developed in varying degrees in different persons. It is the work of the employer to develop the latent or undeveloped factors, he said. One employe may have ability, but be slow in action. In this person "action" must be developed.

Following Mr. Tolles' address, Prof. Earl M. Terry, of the physics department of the university, gave a demonstration of the "Electric Wave and Its Propagation." At the outset he showed a radiogram, which he had just received from Vice-President F. B. MacKinnon, of the United States Independent Telephone Association, at Washington, D. C., sending his congratulations to the Wisconsin association. Much of the lecture was devoted to a demonstration of electric currents as they affect arc lights. In conclusion he showed that there were two kinds of lightning, one that came direct to the earth and the other that traveled from the negative cloud to the positive cloud. In a lecture of this character it is the demonstration that attracts attention and the hundred delegates present manifested the greatest interest. Just at the conclusion a radiogram was received from Secretary Joseph Daniels, of the Navy Department at Washington, extending his congratulations to the members of the association.

Transcontinental Telephone Demonstration.

Friday evening the Wisconsin Telephone Co. gave an hour's demonstration of transmission over the transcontinental telephone line between Madison and San Francisco, Los Angeles and Redlands. P. J. Weirich and others had an interesting conversation with J. C. Kelsey, vice-president of Telephony, on the Pacific Coast. There were upwards of 150 listening cords. At least a score of members of the convention talked with residents in these Western cities. "On Wisconsin" played on a phonograph

in San Francisco at the beginning of the entertainment was applauded by the delegates. The demonstration, in charge of F. M. McEniry, commercial superintendent and C. L. Miller, local district manager, was a great success.

Exhibits were maintained by the following manufacturers: Cracraft, Leich Electric Co., Genoa, Ill.; Stromberg-Carlson Telephone Mfg. Co., Rochester, N. Y.; Fibre Conduit Co., Orangeburg, N. Y.; Garford Mfg. Co., Elyria, Ohio; Julius Andrae & Sons Co., Milwaukee, Wis.; Kellogg Switchboard & Supply Co., Chicago; Monarch Telephone Mfg. Co., Fort Dodge, Iowa; Utilities Indemnity Exchange, St. Louis, Mo.; Reliable Electric Co., Chicago; W. N. Matthews & Brother, St. Louis, Mo.; Cox Lightning Arrester Co., Eaton, Ohio; S-R Electric Co., Illinois Electric Co., and Automatic Electric Co., of Chicago, and the Western Electric Co.

For the first time the Wisconsin Railroad Commission put on an exhibit, which was of great interest to telephone men. The important feature was a large map showing the location of some 1,319 Independent telephone companies and their connecting lines and exchanges. On the map the companies are divided into three classes, according to the number of subscribers, and shown on the map with a suitable legend. The names of the companies are listed on the margin in numerical order, according to file number for handling office routine. Charts with suggested forms for trouble and traffic records were shown as a guide for the smaller utilities; also curves of telephone service in various Wisconsin cities. A second map showed the location of the high power transmission wires in the state.

The room of this exhibit was constantly crowded with telephone men asking for information about matters relating to their company and the commission. The names of over 60 delegates were registered and probably as many others called, but did not register. The exhibit and its attendants were a regular bureau of information.

Western Electric Sales.

The gross sales of the Western Electric Co. for the year ended December 31, 1915, are said to have approximated $64,000,000. This would compare with the actual sales for 1914 amounting to $66,000,000.

The first half of 1915 showed a decided falling-off in the company's business, owing to the general curtailment of expenditures by customers in all parts of the United States. After the first of July, however, sales began to pick up but not in sufficient volume to equal those of the previous year. The net profits for 1914 amounted to $4,033,067. Just what percentage of profits will be shown in the sales for 1915 cannot be ascertained as manufacturing costs differ from time to time. It is assumed, however, that it will be in the neighborhood of $3,500,000.

Mutual Telephone Companies of Ohio Convene.

The annual meeting of the Assembly of Mutual Telephone Companies was held recently at Ottawa, Ohio. Delegates from all parts of the state were present and seven new companies were admitted to membership. Officers were elected as follows: President, Scott Whistler, Bluffton; vice-president, P. A. Kemmerer, Findlay; secretary-treasurer, Cornelius E. Kortier, Delphos. The legislative committee is composed of Henry Williams, Ottawa; G. C. McClure, Columbus Grove; and P. A. Kemmerer, Findlay. It is estimated that there are about 300 mutual companies in the state.

"Dick" Coyne, J. C. Kelsey and Others at the California End of the Madison-Redlands Transcontinental Circuit, February 11.

Employes Presented with Medals for Faithful Service.

At a recent meeting of the Telephone Society, many employes of the Southern Bell Telephone & Telegraph Co., at Savannah, Ga., were presented with badges and pins in recognition of faithful service, including those who have been in the company's employ five years and longer.

Alexandria (Minn.) Company to Install New Plant.

The Alexandria (Minn.) Telephone Co. recently closed a contract for a new common battery system. Work on a new two-story building to house the equipment and also the overhauling of the outside plant will begin as soon as the weather permits. The estimated cost of the new plant is $30,000.

Roses and Snow

Oranges and Telephones—A Splendid Feat

By J. C. Kelsey

The prettiest post card in Sunny California is a picture of a great rose garden backed up by a snow-covered mountain. It makes a magnificent contrast in a land of natural contrast because a reclaimed desert is the greatest antithesis of a plain, everyday desert.

Where else could lemons, oranges, grape fruit, and blossoms thrive on one root? Can one imagine apples, peaches, and plums thriving on one tree in the midst of temperate zone vagaries?

A genius usually has drawbacks. He usually drinks too much whiskey, indulges in drugs, or wastes himself in some riotous fashion. In the long run he evens up matters with the plain, everyday man.

So does a desert bloom and grow riotously when men are diligent and industrious, liberal with water, pruning knife, fertilizer and spray. People do not have to work so hard in the temperate zone, and nature repays them accordingly. Let no man think he can live in a reclaimed desert land except by the sweat of his brow.

I could not help but think of roses and snow when Fred H. Runkel, of Portage, Wis., announced over the telephone that the Wisconsin State Telephone Association was ready for a transcontinental conversation. There were a lot of things I wanted to say, but when I realized the extent of the miracle being performed, my tongue refused to work.

It is a long way from Madison in Wisconsin to Redlands in California. It possibly would be less of a feat to talk between San Francisco and Chicago. But Madison had to connect with Chicago, while the Redlands Independent system had to be connected with Los Angeles, which in turn had to be connected with San Francisco.

Away off in Redlands, it was the greatest pleasure in the world to hear the voices of these Wisconsin telephone men. It was an easy matter to recognize J. M. Storkerson's voice as well as that of W. F. Goodrich. P. J. Weirich, of Monroe, and William L. Smith, of Neillsville, had real telephone voices, as well as Mr. Runkel.

I had the thought, as I conversed with them, that here were men who loved the telephone business and knew that it was the best business on earth.

Wisconsin telephone men particularly remember "Dick" Coyne, who represented the Kellogg company in that state so many years. Mr. Coyne is now the California representative of the Kellogg company.

His conversation, because of its naturalness, with the Wisconsin telephone men made a particularly good test. So many tests of this character fall short because men are usually awed by the wonder of the miracle. When Dick Coyne recognized the voices of his old friends, he forgot the telephone itself.

It reminds one of early day troubles of long distance conversation. You almost had to get a man angry before he would begin to talk.

It is told that it was very necessary to hear from a New York man at one time, and he was afraid to try to use the telephone. When he finally put the receiver to his ear and stammered something, the Chicago man called him a liar and began to abuse him shamefully. The New York man had no difficulty in understanding and he in turn began to become interested and called the Chicago man a few things too. It resulted in curing the man of his nervousness and made him a good user of the telephone. He forgot the telephone itself.

At the Redlands end of the conversation was Charles A. Rolfe, president of the Southwestern Home Telephone Co., of Redlands. Mr. Rolfe was a juror at the Panama-Pacific exposition and his specialty was telephone exhibits and tests.

He is one of the real pioneers in telephone work, beginning in 1877 by manufacturing Edison telephone switchboards for the Gold & Stock company. He equipped exchanges in Utica, Albany, Troy, Rome and neighboring cities in New York state in the early 80's; also exchanges in Mexico City, Chihuahua and Guadalupe, Mexico.

The United States patent office records over 100 Rolfe patents and there are many more to come from his inventive mind. He is, today, California's foremost telephone man.

Besides Mr. Rolfe was Carl D. Rolfe, superintendent of the plant, and daring automobile driver who, last year, pursued the Sunset Limited train for so many miles in order to give me a basket of oranges to take East.

Ernest Erwin, wire chief, assisted by Charles Van Fleet, Alfred White and Hop. Flynn had charge of the test. "Dick" Coyne and L. H. Baldwin, of the Kellogg Switchboard & Supply Co., were interested observers.

It is safe to say that no long distance test was ever made under more natural conditions. A Bell exchange on one end, an Independent exchange on the other, both removed from large exchange centers, truly represents the dream of universal service.

I have just spent one week on a typical telephone situation which applies equally to all corporations. It is the matter of annual reports, to government, state, and a regulatory body known as the state railway commission.

The government is interested in net income, and asks questions particularly regarding wages paid and other items of interest to different departments of government.

The state is interested in gross earnings and demands 4½ per cent. of these earnings as its share of the operation.

The regulatory body of the state goes into elaborate detail and it seems that nothing can escape the all-seeing eye of a paternalistic government.

This age can surely be called the age of publicity, for all skeletons have been rudely torn from their closets. No financial Bluebeard has any chance in this world. It is hard on the companies to do so much extra work, but it is good discipline, anyway.

A few moments ago a typical thing happened. A man rushed into the office out of breath and so angry that he could only sputter. He had tried to use a telephone and found it busy, and after two or three attempts, was told that the line was out of order. He was convinced that he had been sorely treated by the telephone operator and his mental anguish was up to the $10,000 stage.

Upon being asked what telephone it was, and if he was the subscriber, it was found that he was using someone

else's telephone. Naturally he got very little satisfaction, and went away determined more than ever to hate a soulless corporation which did not appreciate his generous use of its service.

It reminds one of the farmer who stole a cushion from a train wreck. It happened to set fire to his barn, whereupon he had the corporation arrested for arson as well as damages.

The way of a corporation is surely hard.

California people have a grudge against their Eastern friends. Year by year, they send boxes of oranges to their friends and year by year, their Eastern friends write them telling of the maple sugar crop and other things, but never sending any.

I hope the conscience-stricken readers of TELEPHONY will remember their California friends better. Send them a box of maple sugar, a big cheese, a ham, or something which thrives in your temperate zone. Don't think that the box of oranges sent you does not represent much labor as well as loving care.

Again the telephone reveals its striking vitality. Owing to the wet weather, many ranch owners and farmers have simply quit. Interest has been widely defaulted and many people, whose living depends upon annual interest, have been put to straits by having their property thrown back on their hands.

But in spite of this difficulty, the telephone company not only pays its interest promptly, but reveals a considerable increase in gross earnings per station. The telephone seems to be a real necessity, although we suspect yet that it is a luxury. The subscription list of a telephone company has stability beyond anticipations.

I cannot get over the wonder of the conversation with the Wisconsin telephone men at the convention last week. I do not believe a better test of the wonder of that long line could be made.

No one knows how many switchboards were in the circuit. It is certain that the Madison and Redlands switchboards were. Both are common battery switchboards which, while of different manufacture, are of standard make, one Western Electric, the other Kellogg.

There can be no suspicion of fraud as is so often intimated, because I know I am in California and that the Wisconsin fellows were in the convention assembled at Madison. Voices were as recognizable as if the conversation were local. Surely no man has a soul so dead as to deny the contribution the Bell company has made to the country. It truly is an eighth wonder of the world.

Many people ask how the Bell company can afford to open its long line to so many functions without charge. It is advertising, pure and simple. It leads into the thought that all long distance service must be advertised and its use encouraged when the cost gets beyond that of a telegram.

You do not have to advertise much to encourage your subscribers to use the telephone when it costs from 25 to 50 cents. But when it comes to messages which cost $1, $2, $5 or $20, you run into an entirely new field of effort. Do not be too reckless in your oft-repeated statement that all the money to be made in the telephone business comes from long distance messages.

There seems to be a tendency to merge telephone companies on the Coast. The method seems to be that of a third company taking over both Bell and Independent and retaining the name of the Independent company. Whether or not the community can, or will, absorb the cost of putting the two together is a problem.

I have in mind one consolidation which gives ten thousand telephones a capitalization of $2,300,000 or $230 per station and which today only pays a gross charge of $23 per year. On the face of it, the rates must be doubled in order to take care of the charges because telephone companies should have a gross earning equal to or better than one-fifth of the capitalization.

Two telephones in one community form a vexing problem and a consolidated telephone, a bigger one.

As long as the world lasts, there will be problems of some kind. The longer I live, the more I believe that the telephone business is the business to stay in. Every man is prone to despise his own business, and likes to see the color of his money occasionally.

If he has that feeling, let him realize that hanging on to his telephone business will give him twice as much during the coming decade as others have made in the past. It's the best business on earth, and I wish all Independents felt as much pride and exercised as much faith as the Bell people do. We have farther to go in these valuable traits.

MORAL: Miracles have not ceased.

Bell Retires from Field of Concord, N. C., Company.

The Southern Bell Telephone & Telegraph Co. has retired from the field of the Concord Telephone Co., of Concord, N. C., and arrangements have been made by the Concord company for connection over the long distance lines of the Bell company.

The Concord Telephone Co. operates telephone exchanges in Concord, China Grove, Kannapolis and Mount Pleasant, and its lines radiate throughout Cabarrus county and the southern portion of Rowan county. For many years the Southern Bell company has operated a connecting exchange in Concord and China Grove, but according to arrangements made for toll and long distance connections in these towns and others in which the Concord company operates the Bell company's exchanges at Concord and China Grove will be discontinued.

Celebrates Completion of New Plant at Tipton, Ind.

Tipton Telephone Co., of Tipton, Ind., held open house to the public on February 9 and 10 in celebration of the completion of its new building and the installation of common battery equipment. The company has spent $35,000 in rebuilding its system. This includes the erection of a new building, the installation of a new common battery switchboard and placing a large amount of its aerial wires underground.

The company has filed with the public service commission through its engineer, J. K. Johnston, a detailed appraisal of the property and an application of increase of rates from $1 for single line residence service to $1.50; from $2 for single line business service to $3.

Convention of Southern States Association Announced.

The Southern States Independent Telephone Association has announced May 23 and 24 as the dates for its ninth annual convention to be held in Knoxville, Tenn. An interesting program is being prepared and full details of the convention will be announced later.

American Telephone & Telegraph Co. Retires Bonds.

Announcement was recently made of the retirement of $42,500 bonds of the American Telephone & Telegraph Co. in exchange for 425 shares of the convertible stock of the corporation.

The Pure Electron Discharge and Its Radio Applications

Thermionic Currents—Theory, Construction, Characteristics and Use of the Pliotron—Paper Presented Before Institute of Radio Engineers, April 7, 1915—Reprinted by Permission from September "Proceedings of the Institute of Radio Engineers"—Final Installment

By Irving Langmuir

In a pure electron discharge, as the temperature of the filament is raised, a point is always reached where the current becomes limited by the space charged between the electrodes. Under these conditions, only a small fraction of the electrons escaping from the cathode reach the anode, whereas the majority of them are repelled by the electrons

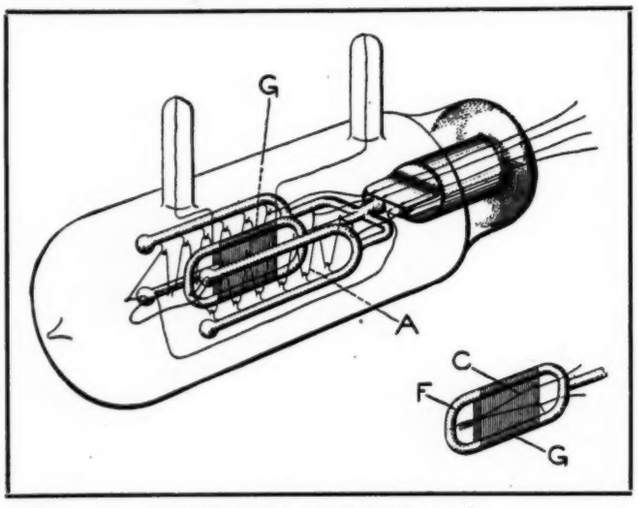


Fig. 4. The Small Pliotron.

in the space and therefore return to and are absorbed by the cathode.

From this viewpoint it is evident that if a negatively charged body is brought into the space between the anode and cathode, the number of electrons which then return to the cathode will increase, so that the current to the anode will decrease. On the other hand, if a positively charged body is brought near the cathode, it will largely neutralize the negative charges on the electrons in the space and will therefore allow a larger current to flow from the cathode. In this way it is possible to control the current flowing between anode and cathode by an electrostatic potential on any body placed in proximity to the two electrodes. This controlling effect may be best attained by having this controlling member in the form of a fine wire mesh, or grid, placed between the electrodes.

Amplifying or Controlling Devices—Pliotrons.

The term "pliotron" has been adopted to designate a kenotron in which a third electrode has been added for the purpose of controlling the current flowing between the anode and cathode. This word is derived from the Greek "*pleion*" signifying "more." A pliotron is thus an "instrument for giving more" or an amplifier. A similar use of the prefix "plio" occurs in the geological term "pliocene."

The three elements, hot filament cathode, grid, and anode, are, of course, similar to the elements of the de Forest audion. However, the operation of the audion is in many ways quite different from that of the pure electron device operating in the way I have described.

In the audion, as in the Lieben-Reisz relay, the amplifying action appears to be largely dependent on gas ionization, even when the device operates well below the point at which blue glow occurs. The action is probably somewhat as follows: There is normally present a small amount of gas ionization, due to the passage of the electrons between cathode and anode. The presence of the positive ions partly neutralizes the space charge which limits the current flowing between the electrodes. If a small positive potential is applied to the grid, the velocity of the electrons passing by it is somewhat increased, and they therefore produce more ions in the gas. Besides this, as the potential on the grid is increased, the number of electrons passing the grid is increased, and this again tends to increase the amount of ionization.

A very slight increase in the amount of ionization brought about in this way, very greatly reduces the space charge, and therefore largely increases the current that can flow between the electrodes. In this way, with a given construction of grid, filament, and plate, the relaying action may be very greatly increased beyond that which would occur if no gas were present. The amount of gas ionization which is necessary, in order to eliminate practically completely the effects of space charge, is often much too small to produce a visible glow in the gas.

If too much gas is present, or if the potential on the plate or the current flowing to the plate is too large, then the amount of positive ionization may reach such values as to neutralize almost entirely the space charge and thus allow a large current to flow. Under these conditions, the relaying action of the audion is lost. This is the case, for example, when the audion gives a blue glow. In the border land between these two conditions, there is a region of instability in which the sensitiveness of the audion may be enormously great, but it is usually not found very practicable to operate the device in this region because of the difficulties in maintaining adjustment, for any lack of adjustment may cause the audion to go over into a condition of blue glow.

The audion is often used with a condenser in series with the grid. Under these conditions, the audion requires the presence of a certain amount of gas ionization so that the positive ions formed may prevent the accumulation of too

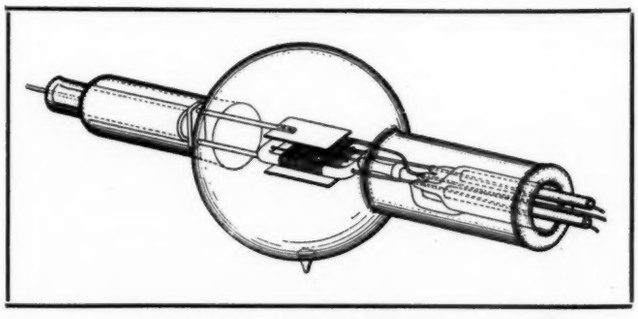


Fig. 5. The Large Pliotron.

large a negative potential on the grid. With the pliotron, owing to the absence of positive ions, if it is desired to use a condenser in series with the grid, this condenser must be shunted by a high resistance and often a source of potential must be placed in series with the high resistance, in order to supply positive electricity to the grid as rapidly as this

tends to be taken up from the electrons given off by the filament.

Construction of Pliotrons.

In the construction of pliotrons, it has been found desirable to make the wires constituting the grid of as small cross-section as possible. In this way, even when a positive potential is applied to the grid, the current that flows to the grid may be made extremely small. The use of very fine wire is made possible by using a frame of glass, metal, or other suitable material, to support the grid. Thus, in Figs. 4 and 5, the filament is mounted in the center of a frame made of glass rods, on which the fine grid wire is wound by means of a lathe. The grid may thus consist of tungsten wires of a diameter as small as 0.01 millimeter and these may be spaced as close as 100 turns per centimeter, or even more.

In Figs. 4 and 5 are shown two types of pliotron. Fig. 4 shows a pliotron such as is used for amplifying radio signals in a receiving station. Fig. 6 shows a large pliotron which may be used for controlling as much as one kilowatt of energy for radio telephony.

The characteristics of the pliotron depend upon the length of filament used, the distance between filament and grid, spacing between the grid wires, diameter of the grid wires, the distance between grid and anode, and the size and shape of the anode. The important elements in the characteristics of a pliotron are:

First, the relation between the current flowing between anode and cathode as a function of the potential on the anode and of that on the grid.

Second, the current flowing to the grid, as a function of the potential of the grid and the potential of the anode.

Fig. 6 gives the characteristics of a small pliotron such as that shown in Fig. 4. Curve A gives the current flowing to the anode for different grid potentials, while the potential of the anode is maintained constant at 220 volts. Curve G gives the current flowing to the grid under the

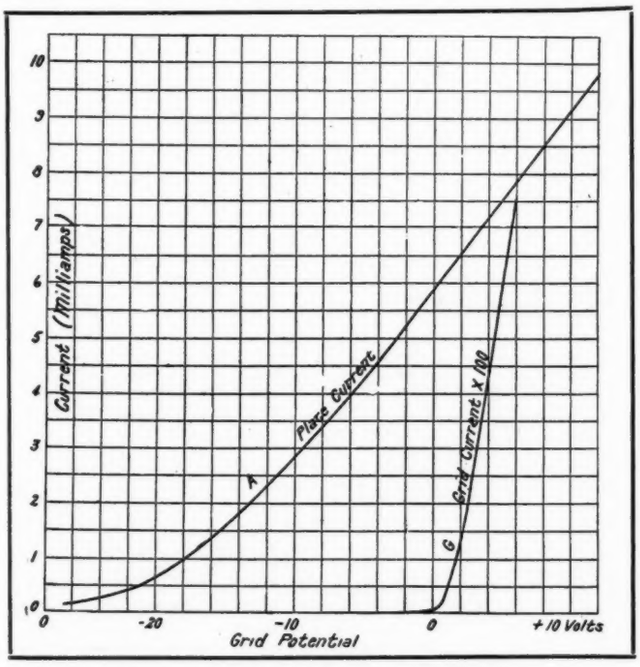


Fig. 6. Characteristics of Small Pliotron.

same conditions. For different anode potentials, these curves are shifted vertically, by amounts proportional to the change in anode potential. In fact, it is found that these curves can be represented with fair approximation by a function of the form, $i = A\,(V_a + k\,V_g)^{\frac{3}{2}}$

where i is the current flowing to the anode, V_a is the voltage on the anode, V_g the voltage on the grid, and k the constant which depends on the relative shapes and positions of the electrodes.

Fig. 7 gives similar characteristics for a large pliotron like that shown in Fig. 5. In this case, the anode potential

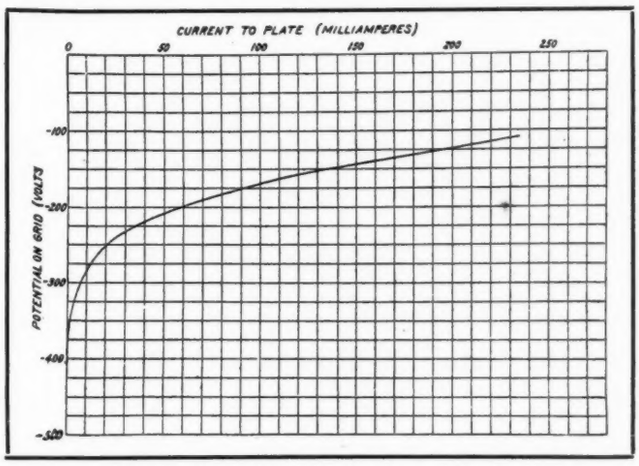


Fig. 7. Characteristics of a Large Pliotron.

was 8,500 volts. Since the grid is at a negative potential, no perceptible current flows in the grid circuit.

By using a fine grid, the current to the anode can be stopped entirely by even a very slight negative potential on the grid. On the other hand, a rather low positive potential will then be sufficient to draw a large current to the anode. The amount of current taken by the grid would be only a very small fraction of that flowing to the anode, in case the diameter of the grid wires is small compared to the distance between them. On the other hand, with a coarse grid—that is, a grid in which the spacing is large—a rather large negative potential may be necessary, in order to stop the current flowing to the anode.

Similar results to those obtained by changing the spacing of the anode, may be obtained by changing the relative distances between the electrodes. The effects produced in this way may be expressed approximately by means of the constant k in the foregoing equation; the effect of fine spacing thus being to increase the value of k, while coarse spacing decreases it.

By using a fairly coarse grid, consisting of fine wire, it is possible to obtain a control of the current to the anode, always using a negative potential on the grid. Under these conditions, since there are no positive ions present, no current flows to the grid, except that necessary to charge it electrostatically to the required potential. It thus becomes possible to control very large amounts of energy in the anode circuit, by means of extremely minute quantities of energy in the grid circuit.

There does not seem to be any upper limit to the voltages that may be used in the pliotrons. With voltages over 30,000 volts, it is often necessary to space the electrodes farther apart and to use heavier wires for the grid, in order to reduce the danger of breakage of the parts by the large electrostatic forces which then occur.

The current carrying capacity of the pliotron is limited only by the size of cathodes that it is found convenient to use, and by the voltage available. Large currents cannot be readily obtained with low voltages because of the space charge effect described previously. With voltages above 500 volts, however, it is found practicable to use currents of 300 or 400 milliamperes for a pliotron of the type shown in Fig. 5.

With high potentials, there is no difficulty in using currents as large as this, provided the energy is consumed in

some device in series with the pliotron. On the other hand, if the full voltage is applied to the anode while the current is flowing to the anode, the energy liberated in the form of heat may be so great as to volatilize the anode or cause it to radiate so much heat that the glass parts of the apparatus are softened. In a pliotron with a 5-inch (12.7 cm.) bulb the amount of energy that may be so consumed within the pliotron is about one kilowatt. Still larger amounts of power may be dissipated if the bulb is immersed in oil and if the grid frame is made of quartz, or other heat resisting material.

It is evident from the characteristics of the pliotron that any number of these devices may be placed in parallel and that in this way, very large amounts of power may be controlled.

Pliotrons in a Radio Receiving Station.

Pliotron as a Detector.

If the antenna of a receiving set is coupled directly to the grid of a pliotron and a telephone receiver is placed in series with the anode, signals may be readily detected, but the results obtained in this way are usually very poor. Under these conditions, the sensitiveness of the arrangement is proportional to the curvature of the curve *A*, Fig. 6 (or, more accurately, proportional to the second derivative of the anode current with respect to the grid potential). This curvature may be somewhat increased by applying a negative potential to the grid but even under these conditions, the sensitiveness of the arrangement is usually not very high.

If it is attempted to use a condenser in series with the grid and thus use the pliotron in the way that the audion is often used (as described, for example, by Armstrong, Electrical

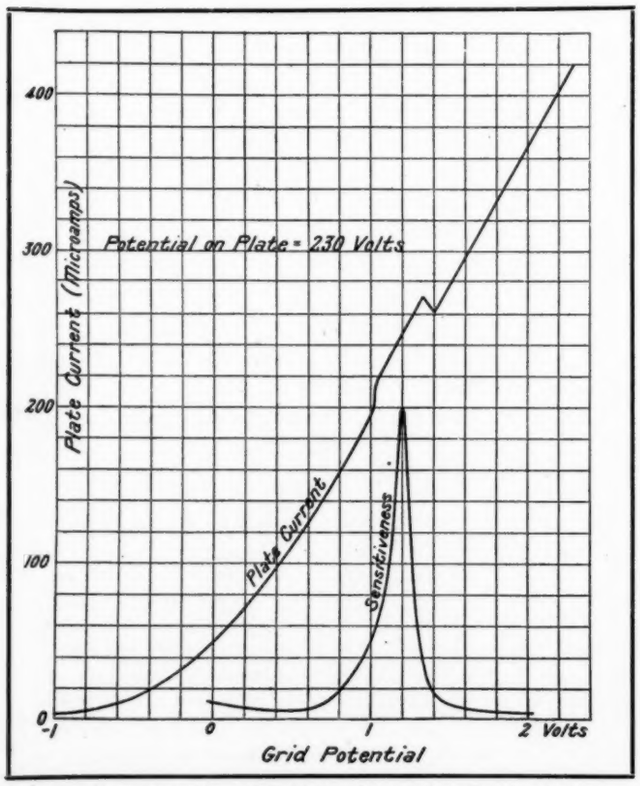


Fig. 8. Characteristics of Detector Containing Trace of Mercury Vapor.

World, December 12, 1914; also this issue of the Proceedings of The Institute of Radio Engineers), it is found necessary to shunt the condenser with the resistance and often to place a battery of a few volts in series with the resistance, in order to prevent a large negative charge accumulating on the grid.

It has been found, however, by Mr. White, that a very minute trace of certain gases may very greatly increase the sensitiveness of this device as a detector. For example, by placing within the bulb a small quantity of an amalgam of mercury and silver, the characteristics of the tube show a kink, as indicated in Fig. 8. With a detector of this sort, if the grid potential is adjusted so that its average value is approximately that at which the kink occurs, there is a very marked increase in sensitiveness. This is due to the fact that under these conditions either an increase or a decrease in the grid potential causes a decrease in the anode current. The sensitiveness of this detector is then very high. The quantities of mercury vapor necessary to give this effect are so low that anode voltage of 200 volts or more may be used without any indication of glow discharge.

Pliotron as Amplifier.

The value of a pliotron as an amplifier is dependent primarily on the slope of the curve between anode current and grid potential—for example, curve *A*, Fig. 6. A second factor of importance is the magnitude of the current taken by the grid. In order to get the greatest amplifying effect it is desirable to have this current as low as possible. In a pliotron of the type shown in Fig. 4, the current to the anode increases at the rate of about one milliampere per volt change in the grid potential.

By using larger anode potentials, the slope of the curve can be made very much greater, since it becomes possible to use grids of finer mesh. For example, in Fig. 7 it is seen that the slope of the curve corresponds to about 1.9 milliamperes increase in anode current per volt change in grid potentials.

It has been found that there is no sluggishness in the characteristics of the pliotron, even at the highest frequencies.

By connecting the pliotron as an amplifier, as shown in Fig. 9, the high frequency currents received from the grid may be amplified from 100 to 600-fold. In this arrangement, it is the high frequency or radio frequency that is amplified, and not the audio frequency.

This amplification of the radio frequency possesses the marked advantage that the detector circuit may be tuned to the same frequency as the amplifier circuit, and in this way a very marked increase in selectivity is obtained. In fact, it has been shown by Mr. Alexanderson that the resonance curve of an outfit consisting of amplifier and detector, both tuned to the radio frequency as shown in Fig. 9, may be obtained from the resonance curve for the detector alone, by squaring the ordinates. For example, if with a single detector, the signals from one station, *A*, are received 100 times as strongly as those from another station, *B*, then, with the foregoing arrangement with the amplifier, the signals from *A* will be received 100 times more strongly, or 10,000 times as strong as those from station *B*. If two amplifiers be used in this way, the signals from station *A* could be obtained 1,000,000 (or 100^3) times as strong as those from station *B*.

In practice, this arrangement has been found to give a wonderfully high degree of selectivity.

Of course, a pliotron may also be used for amplifying the audio frequency, coupling the circuits together by means of an iron core transformer. A single pliotron, under these conditions, gives an amplification of current of several hundredfold, when voltages of from 100 to 200 volts are used on the anode.

Pliotron as Oscillator.

By placing inductance and capacity in the grid and plate circuits and coupling these two circuits together, it is possible to use the pliotron as a source of continuous oscillations. Small pliotrons of the type shown in Fig. 4 may produce oscillations of a power up to a few watts, and these may be used in a receiving station, acording to the heterodyne principle, for re-

receiving continuous oscillations. One pliotron may be used both for amplifying or detecting, and for producing oscillations.

With the larger pliotrons, using voltages of a few thousand volts up to a kilowatt of radio frequency, oscillations may readily be produced by a single tube.

Use of the Pliotron in Radio Telephony.

By means of a single large pliotron, it has been found possible to control about two kilowatts of energy in an antenna by means of the currents obtained from an ordinary telephone transmitter. There are many arrangements by which this may be accomplished. For example, a two-kilowatt Alexanderson alternator (100,000 cycles) may be loosely coupled to the antenna and the anode of the pliotron may be connected to a point on the antenna where the potential is normally high. So long as the potential on the grid of the pliotron is strongly negative, no current flows to the pliotron and therefore the full energy is radiated by the antenna. If, however, the negative potential on the grid is decreased, a sufficient current may be drawn from the antenna strongly to damp the oscillations and thus greatly to decrease the energy radiated. With sufficiently high potential on the grid, practically the whole of the energy may be diverted from the antenna.

It is thus possible to control the output of the antenna by varying the negative potential on the grid of the pliotron. Since the grid is always negative, no current flows between filament and grid, and therefore practically no energy is required to maintain the charge on the grid. In this way, therefore, by connecting the secondary of a transformer between the grid and filament, and placing the primary of the transformer in series with a telephone transmitter, it is possible, by means of the variations in the currents from the telephone transmitter, to obtain potentials on the grid of several hundred volts and thus to control the output of the antenna.

Instead of using an arc or alternator as a source of radio frequency current, the pliotron may also be used as a generator of the oscillations. One pliotron may be used both for producing the oscillations and for controlling the amplitude of the oscillations, in accordance with the variation of pitch and amplitude of the sound waves acting on the telephone transmitter. It is usually preferable, however, to use a large pliotron for producing the oscillations, and to connect a small pliotron in the grid circuit of the large pliotron for controlling the output of the latter.

With this arrangement an extremely simple and efficient radio telephone outfit can be made. Since the pliotron for producing oscillations requires comparatively high direct current voltages, it has been found convenient to combine the pliotron oscillator with a kenotron rectifier. Two types of apparatus of this type have been in use a considerable time, and it will be of interest to describe these in some detail.

In the first outfit, which is a small outfit having a capacity of about 20 watts in the antenna, the source of power is the local city supply, which is 118 volts, 60-cycle alternating current. This is connected with the primary of a small transformer, having two secondary windings. One of the secondaries is designed to give about five volts and furnishes the current used for heating the filaments of the kenotrons and pliotrons. The other secondary of the transformer is wound to furnish a potential of about 800 volts. This is rectified by means of a kenotron and serves to charge a condenser of about six microfarads. In this way a source of high voltage, direct current is obtained in a very simple manner.

The plate of the pliotron oscillator is then connected to one of the terminals of the condenser, while the filament is connected to the other. The plate of the second pliotron is connected to the grid of the first, while the grid of the second is coupled by means of a second small transformer to the microphone circuit.

With this small outfit, both pliotrons may be relatively small, and in order to obtain an energy of about 20 watts in the antenna, it is found that the current drawn from the condenser is so small that the potential supplied by it does not vary sufficiently to be audible in the signals sent out by this outfit. The different parts of this apparatus may be made very compact and no adjustments are found necessary in operating

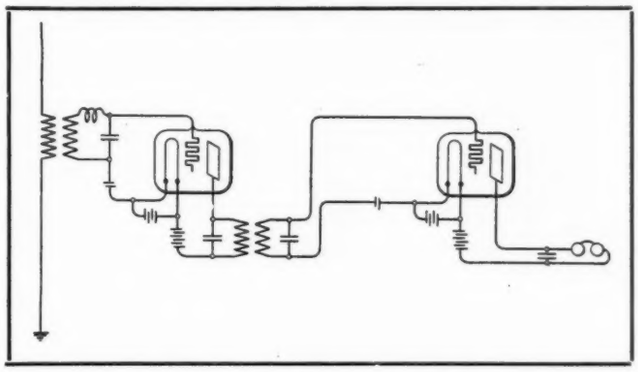


Fig. 9. Arrangement of Two Pliotrons in Cascade, Employing "Tuning in Geometrical Cascade."

the system unless it is desired to change the wave length. In this case, it is only necessary to change the inductance or capacity.

In the second outfit, which is suitable for use up to 500 watts or more, the high voltage direct current is obtained from a small, 2,000-cycle generator. The current from this is transformed up to about 5,000 volts, rectified by kenotrons, and smoothed out by means of condensers. By the use of 2,000-cycle alternating current instead of 60-cycle, it is possible to store up large quantities of energy and thus obtain as much as a kilowatt or more of power in the form of direct current with condensers of moderate size. This high voltage direct current is then used, as before, to operate a pliotron oscillator, the output of which is controlled by means of a small pliotron connected to the telephone transmitter.

By means of this system of control, the amount of energy in the telephone transmitter circuit need be no larger than that commonly used in standard telephone circuits. It has thus been found possible to connect up this radio telephone outfit with the regular telephone lines so that conversation may be carried on between two people, both of whom are connected with the radio stations by means of the regular land lines. It has also been found possible to communicate both ways over these lines.

(Conclusion)

Remodeling of Evansville (Ind.) Plant Completed.

The Southern Telephone Co., at Evansville, Ind., recently completed remodeling its plant at a cost of $25,000. In addition to the greatly bettered equipment, the city of Evansville has also benefited by the change in state laws which made it necessary for the old Cumberland company to turn its holding over to an Indiana corporation. This change made it necessary for the Southern Telephone Co. to establish headquarters at Evansville. The company has installed a rest room for the operators in charge of a matron and has added a cafeteria where food may be had at cost. The company added 800 subscribers in 1915.

Pamphlet on Public Service Rates in Texas Cities.

The bureau of municipal research of the University of Texas published recently a 140-page pamphlet on "Public Service Rates in Texas Cities," covering the rates of a number of telephone companies operating in the state. The bureau will undertake in the near future an investigation concerning the valuations of utilities in the state, and of the taxation of such corporations. The pamphlets are issued free, and sent out by the Editor of University Publications, Austin, Texas.

Fundamental Principles of the Telephone Business

A Reading Course Designed to Present Logically the Principles Which Underlie Successful Organization and Operation of Telephone Properties—Prepared Under the General Supervision of Stanley R. Edwards—Part I, Telephone Economics, by James H. Shoemaker, Completed June 26, 1915—Part II, The Corporate Telephone Organization, by J. C. Kelsey and S. R. Edwards, Completed September 25, 1915—Part III, Telephone Accounting and Auditing, by James H. Shoemaker, Completed January 15, 1916—Installments Now Being Presented Comprise Part IV, Telephone Finance, Written by J. C. Kelsey and S. R. Edwards

Quiz Questions on the Preceding Installment.

13. What is meant by the statement that telephone properties are now on an investment basis? What is the usual interpretation of a speculation?

14. Is there any other cheaper legal method of obtaining money than by borrowing? Show by illustration the advantage of borrowing to obtain funds for the conduct of a business.

15. Has the general idea of the proportion of borrowed capital to owned capital in business changed with the years? What proportion is now deemed within the limits of proper financing? In estimating the proportion, what items on the balance sheet should be excluded?

16. In the illustrations given, what is the apparent percentage of borrowed funds?

17. What advantage accrues to a company operating in its earlier period exclusively on owned capital? What may be a disadvantage of a large amount of borrowed capital?

18. To whose advantage is the policy of borrowing funds more likely to be? What will a study of balance sheets of telephone companies indicate in regard to the percentage of borrowed funds?

19. What are the four classes to which securities may be offered, and what kinds are required by each?

20. In issuing securities, what is the basis for determining the amount?

CHAPTER III. Short-time Loans.

21. *Fixed and Quick Assets.*—The assets of a corporation are divided into two general classes known as fixed and quick assets, the latter being those assets which may readily be converted into money without affecting the carrying on of the business. The fixed assets are, of course, those assets which cannot be readily realized upon and the sale of which would cripple the business. Quick assets are also known as current assets.

22. *Groups of Corporate Assets.*—Corporate assets for the raising of funds are also grouped into divisions as follows:

1. Real estate, buildings, equipment or machinery constitute the principal fixed investment of a corporation.

2. Property which can be sold without weakening the business, such as real estate, stocks in other companies, bonds held as reserves, raw materials and goods in process.

3. Finished products on hand.

4. Accounts receivable.

5. Cash.

6. Intangibles, such as good will, going value, trademarks, etc.

23. *The Assets and Borrowing Values.*—Against the assets in group one, mortgage bonds may be issued. Money can be secured on fair terms on 60 per cent. of the real estate, 50 per cent. of the buildings and 25 per cent. of the equipment or machinery.

If the corporation happens to be a holding company, its principal fixed investment lies in the stock of its subsidiary or licensee companies. On underlying stock, the percentage of money which may be borrowed varies all along the scale. The American Telephone & Telegraph Co. could borrow close to par on its stock in the New York Telephone Co. while what it could obtain on Central Union and some other licensee companies is a question. Just like children in a family, underlying stocks do not all have the same characteristics.

Against groups two and three, some companies issue income and profit-sharing bonds, or preferred stock and short-term notes. Against groups four and five stand accounts payable and bank loans.

24. *Intangible Assets as a Source of Funds.*—The item of intangibles (group six) is something which is of peculiar interest to public utilities, and upon its value depends greatly the value of stock. It is against the difference between the value of the real and tangible assets and their corresponding liabilities that stock issues are made.

Bonds cannot be issued against intangible assets, neither will the bank loan upon them. The only person who will accept them at all is the man who pays down his $100 for a piece of paper which says he is the owner of a share of common stock, the par value of which is $100. From that time on, his hopes and fears depend upon the ability of the management to satisfy the holders of the borrowed capital, and do something more.

25. *Short-term Loans and Their Sources.*—Sometimes companies need money for a comparatively short time, which may be for a period anywhere from 60 days up to ten years, but usually not longer than two or three years. Loans of this type are known as short-term loans. The sources from which money is obtained for short-term loans depends upon the length of time the loan is to run. There are three sources from which loans of this character may be drawn. They are: Trade credits, banks, and notes sold to the public.

26. *Trade Credit as a Source of Short-time Loans May Be Overdone.*—The simplest form of a short-time loan is that of

trade credit. All one has to do to secure a loan of this kind is to buy on credit. In all countries it is customary to give a reasonable time to creditors, unless one is entirely untrustworthy. Thirty days is usually given before trade creditors begin to ask for their money. But if competition exists, and the customer's business is worth while, the time of credit can be lengthened greatly.

In a preceding section (No. 9) has been shown a method of obtaining a longer time than the creditor can reasonably allow. This matter of obtaining extended credit can be overdone, however, as a company may become rated as slow. Being rated as slow pay, it no longer has the best prices quoted to it, for it is natural to assume that the creditors must charge the slow-pay company for the trouble and delay in dealing with it. In such an event, the advantage of long-time credit is entirely lost and other sources of credit are endangered as well. No bank cares to deal with slow-pay people, neither does it care to buy their notes.

A company does not obtain trade credit to advantage when the loss of the trade discount is greater than the prevailing discount on bank loans. The discount usually allowed for cash payment within ten days, is also a consideration which should be kept in mind.

27. *Short-time Loans from Banks.*—As has been previously stated, banks are dealers in credit and furnish capital to carry on commercial enterprises. As a bank must meet every check drawn upon it, it must have its assets in such shape as to be readily realized upon. For this reason, its loans are confined almost entirely to loans payable upon a demand and short-time loans for specified periods such as for 60 or 90 days. At the end of these periods banks may renew the notes if conditions are such as to warrant them in doing so.

Although bank loans are usually made on undoubted security, they are said to be 90 per cent. unsecured, showing that character is still the greatest collateral at American banks. This fact has been given exceptional prominence as a result of the statements made by the late J. P. Morgan in his testimony before the Pujo investigating committee in 1912. He astonished every one by saying that "character is the basis of credit" and that he would loan money on character alone.

The real secret of credit and accommodation at a bank is acquaintance. The treatment of a stranger is entirely different from one who is known, time-tried and true. Banks are as human as are their directors and officials, and banks are just as keen after customers as any manufacturer. The largest banks in Chicago will follow up the withdrawal of an unimportant account to ascertain what the trouble has been.

28. *Considerations Influencing Granting of Loans by Banks.*—It is now the custom of many banks, in the larger cities especially, to require a statement from prospective borrowers which indicates in detail all assets, liabilities of various kinds, financial operations and methods, property owned, busiest seasons, etc. It is from an analysis of such statements that the banker forms a conclusion as to the advisability of granting a loan. Personal acquaintance with and knowledge of the character of the applicant for a loan are also the basis for a favorable or unfavorable decision.

According to a Philadelphia banker, in an article in The Journal of Accountancy, a large amount of notes receivable indicates that a company has been granting unsafe credits. Well-managed corporations which have any amount of notes receivable usually discount them, but they are then a contingent liability, a large amount of which is not regarded with favor.

It is further stated that "corporations which show too much under the head of notes receivable, are to be looked upon by a banker with distrust."

This statement is, however, hardly fair because many companies prefer to handle their own paper and will not discount it at the banks. In telephone practice, it is generally conceded that such notes will not be turned over to the banks.

The banker also looks at the merchandise account, although care must be taken to inquire into fluctuations of price. All other assets have no charm for the banker at all—he fears that the building the company occupies is only good for the purpose of the company and valueless for any other line. He thinks the machinery and equipment would be but junk. The question of net profits and gross sales, dividends paid, and bad debts comes in for analysis too. A statement based upon inventory and an actual audit by a responsible firm will prove the greatest help in obtaining a credit standing.

29. *Practices Not Regarded With Favor by Bankers in Considering Loan Applications.*—A corporation is not expected to assign its accounts receivable, as such a practice does not look well to the banker. The banker is liable to demand that the corporation carry sufficient insurance as a fire not only ruins assets but deflects earnings for a considerable period.

It is a generally recognized financial rule that a corporation shall not borrow extensively at its bank, and at the same time sell large amounts of commercial paper. It is also a rule that bond debts should be in a definite proportion to the fixed assets. No banker cares to loan money to a corporation which is bonded beyond certain limits. Sometimes bonds cover the fixed assets, so it is well that the character of a corporation's bond be studied by both banker and trade creditor.

(*To be Continued.*)

Employers' Liability Act in Argentina.

Argentina, South America, has adopted an employers' liability act which extends protection to all employes receiving not more than 3,000 pesos ($1,274) annually who work in factories or any establishment where power is used. The law applies also to employers of labor on buildings, railways, harbors, dikes and canals; in mines and quarries; in transportation, loading and unloading; in the manufacture and use of explosives, inflammable material, and electricity; in telephone, telegraph, and lighting service; in lumbering; and in agriculture where it involves the use of motors. Employers may insure their workmen against accident, provided the benefits are not less than those specified in this law.

Work Begun on Telephone Exchange in Louisville, Ky.

Work has been begun on the new Highland exchange building of the Louisville Home Telephone & Telegraph Co., in Louisville, Ky. The company has completed the conduit system in that section. The new building will represent several advanced ideas in exchange construction and, when completed, with the other three exchanges, will give the Louisville Home a total capacity of between 40,000 and 50,000 telephones.

Proceedings Before Commissions, Courts and Councils

Discussions and Rulings of State Bodies Having Supervision Over Telephone Companies, Decisions of Courts in Matters of Interest to Public Utilities and Actions of City Councils Relative to Franchises, Rates and Service

Telephone Bills in Kentucky Legislature.

Favorable action has been taken by the upper house of the Kentucky state legislature on the Helm bill which extends the powers and jurisdiction of the state railroad commission to cover the telephone, telegraph, steamboat and express companies in the state. This is an administration measure and it is expected will be passed by the lower house, while the governor's approval is a foregone conclusion.

Under the laws of 1912 the railroad commission has limited jurisdiction as regards physical connection and consolidation.

Favorable action in the house is also expected on the Combs bill which would call for an amendment to the constitution to permit competing telephone companies to consolidate under the proper restrictions. This measure has had the approval of the senate and is getting the support of the business men in most of the smaller towns, as well as in the larger cities of the state. It would be at least four or five years before such a revision of the present law could become operative and, since all operating companies are now protected by their charters, there is no disposition on the part of the telephone companies to contest action on the measure.

Representative Pickett, of Shelbyville, has introduced a measure in the house which would require all common carriers to state the true consideration for services.

Settlement of Mountain Home Telephone Case.

The New York Public Service Commission, finding that the complaints of the Board of Trade of Malone, N. Y., and others against the Mountain Home Telephone Co. have not been proven in any respect, on February 10 dismissed the case. Analyzing the testimony that has been presented in the light most favorable to the complainants Commissioner Irvine finds that it shows the company's return on its property employed in the public service was but three-fourths of 1 per cent. in 1914 and 1¾ per cent. in the first half of 1915, without including interest charges in the expenses.

"The complaint," says the opinion, "so far as it affects the rates is, therefore, not justified. So far as it affects the service it was at the time it was filed justified, but improvements have been made, and no specific order is now practicable which would insure further improvement. This must be left to the continuing efforts of the company and the continuing supervision of the commission."

In this connection inspectors of the commission have been watching the operations of the company all through the pendency of this case, and they report that while they at first found the company in bad shape, because it was just being reorganized and because of the effects of a severe sleet storm, equipment and operating methods have been improved as rapidly as possible, and are now in a satisfactory condition. Such instances of bad service as were brought forward by the complainants, the commission finds, are now only such as must inevitably occur in occasional individual cases, no matter how well a property is run.

The commission finds that the overloading of the rural lines, which was a just cause for complaint when the complaint was filed, has now been done away with.

With regard to toll charges between Malone and certain other points formerly included in the Malone free area, notably the Burke and Chateaugay exchanges, the commission finds no way, in view of the company's present financial condition, to order these eliminated, but recommends to the company the careful study of some way in which more extended service can be given the smaller exchanges outside of Malone.

The commission finds that there is no way that it can compel the company to be bound by the terms of the old Ward franchise, which belonged to its predecessor, the Adirondack company, as the present company purchased only the physical property of the Adirondack company and not its franchise, and is now operating under a franchise acquired from the New York Telephone Co.

"The demand to restore them, after many years of acquiescence in the higher rates," says Commissioner Irvine of the rates in force under the old Ward franchise, "would, even by a court of equity, be deemed a stale demand."

In the early stages of the proceedings the commission determined that it had not the jurisdiction to compel the dissolution of the Mountain Home company into its constituent corporate parts, or to decree a restoration of property already legally transferred. The commission then offered to submit this question of jurisdiction to the courts if the complainant desired, but this offer was not availed of and the commission maintains its position on this feature of the complaint.

The decision of the case of the Malone Board of Trade vs. the Mountain Home Telephone Co. carries with it the dismissal of similar complaints by patrons of the Chateaugay and Burke exchanges regarding toll charges, and by Pomona Grange as to rates in Canton. All these cases were heard together, and the same decision is made for all, on the grounds set forth in Commissioner Irvine's opinion.

In considering the question of rates Commission Irvine said that though the commission is bound by the decision of the court of appeals to impose the burden of proof upon the complainants, after the complainants had submitted such evidence as they could, the commission required the company to submit evidence of the value of its property upon which the complainants could criticise the items. The company adduced the inventories and valuations made before the company was consolidated under the checking of the commission's engineers and accountants, and from this the commission struck a number of items until the final sum held for the purposes of this case to represent the value of the property employed in the public service was but the "bare bones" of value, excluding all intangible or speculative values. Even on this the company showed it was earning but a mere shadow of an adequate return.

Though Commissioner Irvine finds that the evidence of a former manager of this property was so indefinite as not to weigh against the evidence of the company and the commission's own engineers, for lack of evidence to support it he strikes from his consideration of the value the item of $226,732 claimed for right of way. This left $1,260,592 as the valuation figure considered for the purposes of the case. The tax returns submitted by the complainant to set a lower value, Commissioner Irvine finds to be excluded by many decisions of the courts.

Commissioner Irvine also reduces the allowance for depreciation claimed by the company to $75,000. Yet, even with these cuts in favor of the complainants' contentions, the company is shown to be earning but the ¾ per cent and the 1¾ per cent. previously alluded to.

The only change in the present schedule recommended for the study of the company is a possible flat rate of $6 a year for extension telephones.

The commission has also found that it is without power to adjust, and has dismissed the complaint of the Paul Smith Hotel Co. against the Mountain Home Telephone Co. as to rates. The commission finds that the Paul Smith company has never submitted itself to the jurisdiction of the commission as a telephone corporation, and that it is not an ordinary subscriber to the service of the Mountain Home company, as it has practically an independent system of its own connected with the Mountain Home system on a contract basis.

The law requiring the exchange of dispatches between companies the commission finds, is plainly applicable only to telegraph companies, and the commission is hence without power to handle the situation complained of.

Validity of Contract for Reduced Rates to County.

The Wisconsin Railroad Commission on February 9 entered an order disposing of the reduced service controversy between the Ashland (Wis.) Home Telephone Co., and the county board of Ashland county, by ruling in favor of the contention of the telephone company. It appears that prior to March 1, 1903, the county and the telephone company entered into an agreement whereby the telephone company was to furnish all telephones the county might need at $12 per annum each, payable monthly, each telephone to be a separate line. The contract did not run for any specified time. Eight telephones were placed in service and up to January 1, 1908, the service was paid for in accordance with the contract.

On July 1, 1908, the telephone company notified the county that under the ruling of the Wisconsin commission, under the public utility act, the rental charge would thereafter be the same as all its patrons, $30 a month for each independent telephone line and $12 for each extension. For the years 1908, 1909 settlement for service was made on this basis. Other telephone lines were ordered in and then the county board disallowed the bills. This was done by the county, first, on the ground that the telephone company was not charging the original contract price; and, second, because the ruling in the Superior free telephone case indicated that they might be entitled to service for a contract rate.

The matter was taken into court. Judge Risjord held that the contract entered into in 1903 was terminated in 1908, when the new contract was mutually entered into by the parties. From this ruling appeals were made to the supreme court. Later the case was withdrawn from the courts and the whole matter submitted to the railroad commission and given a hearing January 26 of this year.

The commission, after discussing the Superior free telephone case, as decided by the supreme court, and a more recent franchise case, which arose in Kenosha, says there are two contentions in the Ashland case:

"First, that the contract between the county and the telephone company was binding during all this time upon the telephone company. The circuit judge of Ashland county found that this was not so. He found the contract was one that could be set aside and that the parties had set it aside. We think that Judge Risjord was correct. Whether correct or incorrect, this commission is bound by that determination of the law.

Second, it is now claimed—and this point does not seem to have been before the circuit judge—that the so-called franchise from the city of Ashland to the telephone company provided for this service at $12 a telephone, etc. We believe that this contention is ruled absolutely by the decision of the supreme court of the state of Wisconsin in Kenosha vs. the Kenosha Home Telephone Co., 149 Wisconsin, 338.

Third, there are no papers before us from which it can be said that the commission was expected by the parties to investigate the reasonableness of the charge heretofore made; that is, whether the rates filed with the commission were reasonable or not reasonable. No facts were stipulated from which this matter could be judged; nor was any testimony relating thereto introduced. The rates filed are presumed to be reasonable until attacked. An investigation into the reasonableness of rates involves a long and expensive procedure. Under the public utilities act we can investigate for the purpose of fixing rates for the future and this we do on proper complaint, but we do not understand that the stipulation is a complaint of that nature.

We should not make any such investigation unless a complaint charging that the rates were unreasonable was formally filed with us. But even should this be undertaken by the commission, the rates established, if they differed from the present rates now on file, would be in force only from the time fixed by the commission. They would not react on past service, nor do we think that the county is any more entitled to a rate different from that filed than are other consumers; that if a refund is to be made the county from a filed rate, there is no reason why it should not be made to others.

It will thus be seen that upon the record now before the commission on the first point we have the judgment of Judge Risjord; on the second point the direct decision of the supreme court of the state of Wisconsin; and the third question of reasonableness of rates is not before us."

Hearing on Telephone Investigation in Washington.

After a day's recess to give the engineers of the company and the public service commission an opportunity to consult further in their efforts to arrive at an agreement on the valuation of the Pacific Telephone & Telegraph Co. in the state of Washington, the hearing was resumed on February 4. After a brief session, at which G. E. McFarland of San Francisco, president of the Pacific company, gave the value of its property in the state as $22,000,000, the commission adjourned until February 23 its hearing to determine the figure on which Mr. McFarland testified.

The postponement was made at the instance of Attorney J. T. Shaw, representing the company. Mr. Shaw said that the witnesses the company had intended to put on had been scattered far and wide to maintain service in the face of the snow storm and that the company's engineers and those of the state are still unsuccessful in their efforts to reconcile differences.

The company's witnesses had previously put the actual cost of construction at $19,000,000 and the cost of reproduction on December 31, 1915, at $26,000,000. Mr. McFarland's figure was for December 31, 1915.

Court Upholds Commission in Boswell, Ind., Case.

The decision of the Indiana Public Service Commission refusing permission to the Farmers & Merchants Telephone Co. to enter Boswell, Ind., a territory already occupied by the Boswell Telephone Co., has been upheld by James P. Wasson, acting judge of the circuit court, at Fowler, Ind.

The new company after being refused the permit by the commission, set its poles and strung wires, which the employes of the Boswell company promptly put out of service. The alternate stringing of the wires and the cutting of them was carried on in good feeling, the wire cutters waiting courteously until the builders had finished and vice versa.

In the trial of the case the attorneys for the Farmers & Merchants company bitterly assailed the decision of the commission, declaring it had a tendency to create a monopoly. Judge Wasson's decision perpetually enjoined the Farmers & Merchants company from doing business in Boswell until such a time as the commission shall decide that public convenience and necessity require another company.

The Farmers & Merchants company will appeal to the supreme court.

Objections to Competing Exchange at Sterling Withdrawn.

The appeal of the Lincoln Telephone & Telegraph Co. from the order of the Nebraska State Railway Commission in the matter of the Peoples Telephone Co. of Sterling, was recently dismissed by agreement between the Lincoln company and the organizers of the Sterling company. By stipulation the costs are to be paid by the Lincoln company.

The Sterling company proposed to establish a competing exchange and its right to do so was challenged by the Lincoln company which is operating an exchange at Sterling. The railway commission was asked to approve an issue of capital stock by the new company. A majority of the commission decided that while a second exchange in Sterling would be detrimental instead of beneficial, it had no authority of law to refuse approval of the proposed issue of capital stock. The commission reduced the amount of capital stock deemed necessary to finance the new company and gave approval to the issue. The Lincoln company appealed from this order to the supreme court.

"It simply means that the company withdrew its objections," said General Manager L. E. Hurtz, "and the order of the state railway commission stands. That was the only 'settlement' there is about it."

Reduction in Rates at Kalispell, Mont., Denied.

In an order issued February 8 the Montana Public Service Commission refused to reduce the telephone rate on a rural line out of Kalispell, on the ground that the concern was a losing proposition. Farmers of Kalispell had filed complaint, alleging that the Northern Idaho & Montana Power Co. was charging too high a rate for its service.

They also complained of poor service. The complaint referred to the month of August when the line was out of order for three weeks. The testimony showed that during this period there were many violent thunder storms which had ruined the main cable. The commission ordered the company to credit the subscribers with $1.50 each by reason of the failure of the company to furnish satisfactory service last August.

Agreement Relative to Rates at Rensselaer, Ind.

A hearing was held by the Indiana Public Service Commission on February 10 on the application of the Jasper County Telephone Co., of Rensselaer. By suggestion of the commission's representative, the attorneys for the telephone company and the attorney for the citizens of Rensselaer went into consultation with J. K. Johnston, engineer for the company, and settled on a basis allowing the company to charge an increase of 25 cents for single line metallic residence service and an increase of 25 cents for extension business telephones. The tentative agreement was signed by both parties and presented to the commission.

Bell Must Connect with Toll Lines at Owatonna, Minn.

The Minnesota Railroad & Warehouse Commission, on February 10, issued an order requiring the Northwestern Telephone Exchange Co. to make connections with the toll lines of the Tri-State Telephone & Telegraph Co., at Owatonna, Minn., within 20 days or show cause why such connection should not be made. This order was made at the request of the city of Owatonna and is the first ruling under the Minnette law requiring connection of competing companies under certain conditions.

Hearing on Interference of High Tension Lines in Iowa.

The Iowa Railroad Commission will hold a hearing on March 16 on the subject of interference of high tension wires with telephone and telegraph lines. The subject is one of great importance to Independent telephone companies of the state, and it is expected that they will be well represented at the hearing. The date set for this hearing is the last day of the annual convention of the Iowa Independent Telephone Association, thus making it most convenient for many telephone men to attend the hearing, as well as the convention sessions.

Necessity of Appeal to Public Service Commission.

Under the New York laws of 1910, chapter 673, the public service commission was given general supervision and control over telephone and telegraph companies. The public service commissions law, section 92, requires telephone companies to file with the commission schedules of rates, and prohibits the charging of different rates than those specified in the schedule. Section 97 confers upon the commission jurisdiction to determine the tariffs which may be charged. The plaintiff ignored the commission, and brought his action directly to the courts. It was held that he could not recover for alleged illegal charges without an appeal to the commission, from whose decision, if discriminatory, he could appeal to the courts. Murray vs. New York Telephone Co., Supreme Court of New York; 156 New York Supplement, 151.

Judgment Awarded for Injuries to Lineman.

Carl Kirchgessner, suing through his father, William Kirchgessner, was awarded an $800 judgment against the Citizens Telephone Co., by a grand jury in the circuit court at Grand Rapids, Mich., as the result of injuries received on July 2, 1915, when he was hit on the head by a spike dropped by a lineman from the top of a telephone pole. His hearing was injured and his nervous system impaired, it was alleged.

Nebraska Telephone Co. to Issue Refunding Notes.

The Nebraska Telephone Co. has been granted permission by the state railway commission to issue $4,000,000 of new notes, bearing 4½ per cent. interest, for the purpose of refunding an equal amount of 6 per cent. notes about to fall due. The new series will be dated April 1, 1916, and will mature February 1, 1918.

Physical Valuation of Connersville (Ind.) Company.

A physical valuation is being made of the Connersville (Ind.) Telephone Co., to be filed with the Indiana Public Service Commission in evidence against the protest of an increase in rural rates.

Reduction in Toll Rate to Iron River, Wis.

The North Wisconsin Toll Line Co., of Washburn, Wis., on February 1 put into effect a new toll rate to Iron River, Wis. The new rate is 16 cents flat, a reduction of five cents from the former charge.

Injury from Wires.

Where a telephone company allowed its wire to dangle into a highway which ran parallel to an electric railroad with a bare third rail, so that it might reasonably have been anticipated that children would be attracted to play with the wire

by throwing it upon the third rail and seeing the sparks fly, or that the wind might blow the wire against the rail, such telephone company was liable for the death of one who received a shock from a wet fence against which the wire had been placed either by the wind or by children, since the company was liable unless a responsible and independent human volition intervened between its negligent act and the fatal consequence. Kruis vs. Grand Rapids, Grand Haven & Muskegon Railway & Citizens Telephone Co., Supreme Court of Michigan; 155 Northwestern, 742.

Regulation of Charges.

The defendant telephone company's predecessor received a grant in 1887 to operate a telephone line which required the installation of the most modern and improved instruments and appliances, and provided that for a certain class of service the rate for a single ground return line for a period of six years from 1887 should be $48 per year. At the expiration of that period the rate was increased for metallic circuit to $100. In 1897 the defendant reduced that rate to $80, and received a further grant to put its lines underground upon condition that it should not thereafter raise its rates. The plaintiff sought to require the company to furnish him telephone service at the rate of $48. The court held that the original grant had no application after the six-year term, that the condition of the grant of 1897 that the rates should not be raised did not apply to the original rates, but to the rates then in force, and that he could not require the company to furnish the metallic circuit at the original rate of the 1887 grant. Murray vs. New York Telephone Co., Supreme Court of New York; 156 New York Supplement, 151.

Summary of State Commission Hearings and Rulings.

COLORADO.

February 14: Continued hearing on state-wide investigation, upon the commission's own motion, of the Mountain States Telephone & Telegraph Co. with a view of determining the reasonableness of its rates, regulations, etc.

ILLINOIS.

February 15: Hearing in the case of the city of Peoria vs. the Central Union Telephone Co., alleging excessive rates.

February 23: Continued hearing on the joint application of the Central Union Telephone Co. and the Decatur (Ill.) Home Telephone Co. for the purchase of the Decatur Home company by the receivers of the Central Union. The hearing was continued to permit further conferences between the various parties interested in the establishing of satisfactory toll contracts.

INDIANA.

February: Kirklin (Ind.) Telephone Co. granted permission to change from a partnership to a stock organization and to issue $15,000 in capital stock.

February: Petition filed by the Farmland (Ind.) Telephone Co. for permission to increase its monthly rental 25 cents with the understanding that all bills for rentals and tolls paid before the tenth of the month will be subject to a 25-cent discount for prompt payment.

February 3: Hearing on application of the Farmers Mutual Telephone Co. for connection with the Commercial Telephone Co., of Warsaw, Ind.

February 10: Petition filed by the Home Telephone Co., of Elkhart county, asking that free service be eliminated, between Elkhart and Goshen, giving the company the right to charge 10 cents for each message.

February 10: Hearing on application of the Jasper County Telephone Co., of Rensselaer, for an increase in rates. An agreement was reached between the attorneys for the telephone company and the attorneys for the citizens upon an increase of 25 cents for single line metallic residence service and an increase of 25 cents for extension business telephones.

February 23: Rehearing of the petition of the Cloverdale (Ind.) Telephone Co. for an increase in rates. The increase was granted by the commission a short time ago and as a result about half of its patrons in Cloverdale have ordered their telephones removed.

March 1: Postponed hearing on the complaint of the Martinsville (Ind.) Chamber of Commerce against the Martinsville Telephone Co. alleging poor service.

March 1: Hearing on petition for approval of the merger of the New Long Distance Telephone Co., the New Telephone Co. and the Indianapolis Telephone Co., of Indianapolis, Ind. This hearing was originally set for March 8, but has been changed to this date.

IOWA.

March 16: General hearing on the subject of interference of high tension lines with telephone and telegraph lines.

KANSAS.

February 24: Hearing on application of the Missouri & Kansas Telephone Co. for authority to change rates in the city of Wellington, Kan. Case No. 1153.

MICHIGAN.

March 1: Final hearing of the Michigan State Telephone Co.'s application for metered rates in the Detroit metropolitan zone.

MINNESOTA.

February 10: The commission ordered the Northwestern Telephone Exchange Co. to make connections with the toll lines of the Tri-State Telephone & Telegraph Co. at Owatonna, Minn., within 20 days or show cause why such connection should not be made.

MONTANA.

February 8: The commission denied the application of farmers of Kalispell, Mont., asking that the Northern Idaho & Montana Power Co. be required to reduce its rates on a rural line out of Kalispell. In regard to the complaint of poor service, the commission ordered the company to credit its subscribers with $1.50 each for the month of August, during which month the line was out of order three weeks, due to violent thunder storms.

NEBRASKA.

February: The commission granted the Nebraska Telephone Co. permission to issue $4,000,000 of new notes, bearing 4½ per cent. interest for the purpose of refunding an equal amount of 6 per cent. notes about to fall due. The new series will be dated April 1, 1916, and will mature February 1, 1918.

February 16: Hearing on application of the Tri-State Telephone Co., of Chadron, Neb., for permission to issue $150,000 of stock and $75,000 of bonds.

February 25: Postponed hearing on the application of the Lincoln Telephone & Telegraph Co. for permission to increase its farm line rate at Wahoo, Neb., from $1 to $1.25.

NEW YORK.

February 10: The commission dismissed the complaints of the Board of Trade of Malone, patrons of the Chateauguay and Burke exchanges and the Pomona Grange against the Mountain Home Telephone Co., the commission finding that the complaints have not been proven in any respect.

WASHINGTON.

February 23: Continued hearing at Tacoma on state-wide investigation of the Pacific Telephone & Telegraph Co. with a view to establish a fair value upon which to base rates.

WISCONSIN.

February 4: The commission authorized the East Valley Telephone Co., of Campbellsport, to issue $16,000 in stock for the purpose of paying for its plant and making extensions and improvements.

February 9: Controversy between the Ashland (Wis.) Home Telephone Co. and the county board of Ashland county relative to an old contract for service to county at reduced rates, settled.

February 12: Hearing in the case of E. W. Posselt, et al., vs. the Larsen Telephone Co., and the Readfield Telephone Co., relative to physical connection. U—872.

February 15: Hearing set for this date on the application of the Western Crawford County Farmers Telephone Co. for permission to increase rates has been indefinitely postponed, on request of C. L. Crawford of the Farmers company.

February 15: Hearing on application of the Union Telephone Co. for permission to increase rates. U—879.

February 18: Hearing on application of J. E. Baker, et al., for an order requiring physical connection between the Cadott Telephone Co. and the Wisconsin Telephone Co., at Stanley, Wis. U—876.

February 18: Hearing at Fall River in the case of P. J. Girard, et al., vs. the Peoples Telephone Co. U—875.

February 24: Hearing on application of the Beef River Valley Telephone Co. for authority to increase rates. U—880.

February 25: Hearing in the case of the Rosendale Telephone Co. vs. the Wisconsin Telephone Co. as to rates and service. U—708.

February 29: Hearing on application of Baldwin's Mills Telephone Co. for permission to increase rates. U—881.

February 29: Hearing in the case of the City of Lancaster vs. the Wisconsin Telephone Co. and the Farmers Telephone Co., relative to physical connection. U—871.

"Telephony's" Home Study Course for Telephone Men

A Complete Presentation of the Principles Underlying Modern Telephony in All Its Branches—Arranged Systematically So That Regular Reading and Faithful Study Will Qualify Ambitious Men for Higher Positions—Prepared Under Supervision of Stanley R. Edwards—This Section Written by Jay G. Mitchell

Quiz Questions on the Preceding Installment.

310. State an important consideration bearing upon the design of relay windings entirely aside from electrical efficiency.

311. How is the battery capacity required for the execution of each part of the telephone call for any given period, such as one day, calculated?

312. Aside from line resistance and leakage, what element in the equipment assists to determine the battery capacity required to handle any given amount of telephone traffic in common battery offices?

313. Give some of the reasons why calculated coil windings do not always coincide with the result obtained.

314. Using the curve in Fig. 128, determine how many turns of No. 28 single silk insulated wire can be placed in the winding space of the coil shown in Fig. 126.

315. Why is there a greater strain on the insulation between the last turn of the second layer and the first turn of the first layer, than there is between the last turn of the first layer and the first turn of the second layer of the winding in any coil?

CHAPTER XV. Coil Windings (Continued).

316. *Loose coil windings and possible effect on insulation.*—It has been shown how every solenoid carrying a current becomes a magnet in itself even when it is not provided with an iron core. The magnetic properties of the solenoid are due to the combined magnetic effect of all its turns acting in unison. Each complete turn carrying a current around the circumference of the solenoid might properly be considered a very weak magnet. When, for any reason, some of the turns of a coil become loosened in their places, as the current flows through them, this mutual attraction is very likely to cause them to vibrate, when the current varies, causing a variable magnetic attraction between them. If the windings are mechanically supported in their proper places, such a condition cannot, of course, occur.

In coil windings subjected to the magnetizing effect of alternating currents, such a condition is especially likely to cause trouble. It is obvious that, if the wire of any part of a winding continues to vibrate, although its actual travel to and fro may be very slight indeed, and if the wire in question is wound with a silk or cotton wrapping, the continual vibration is almost sure to loosen the insulation on the wire and afford a cause for trouble by lowering the insulation resistance between turns. Moreover, since the cotton or silk insulation of any magnet wire consists of a more or less closely placed set of fibers wrapped around it, it is very possible that in winding, these threads or fibers may become slightly separated, leaving the metal of the wire more or less exposed. This is not so likely in the case of double and triple wrapped wires, but experience has demonstrated that the possibility exists in all kinds of wrapped insulation.

317. *Impregnation of coils.*—There are many insulating varnishes available which, if applied, would weld the silk or cotton insulation of a wire into a solid covering. They would also cement all the wires of the winding into a more or less solid mass if it were possible to insert them. To a great extent the same effect may be secured if the insulating varnishes permeate the insulation on the wires of the winding and fill, more or less, the spaces between the adjacent turns.

The general name for the process by which this result is accomplished is known as impregnation of the coils. It is carried on by different manufacturers in one of three general methods. In the case of enamel insulated wire, however, it is usually considered sufficient to place a layer of paper or oiled muslin between the layers. With silk and cotton insulated coils, the process is as follows:

Some coil manufacturers immerse the finished coil in the insulating varnish and allow the varnish to penetrate as far as it will into the insulation and into the spaces between the wires. Another method in use consists in passing the wire through a bath of the insulating varnish as it is being wound on the bobbin. A variation of this method that gives very good results in the small coils required for telephone apparatus, is to paint each layer with the insulating varnish as it is completed.

318. *The vacuum method of coil impregnation.*—Undoubtedly the most perfect method of impregnation is the vacuum method. In this method the coil is placed in an air-tight receptacle and the air is practically exhausted. By proper means, such as steam heat, practically all the moisture is expelled from the receptacle and the coil. When a sufficiently complete vacuum has been obtained—the degree of vacuum is only determined by experience—the insulating compound is admitted to the partially exhausted receptacle at atmospheric pressure. Since no air is admitted with it, the insulating compound fills the spaces between the turns of the coil and permeates the wrapped insulation. By subsequent application of air pressure, the insulating varnish is driven into the winding very thoroughly.

A somewhat less perfect variation of the vacuum process consists in placing the coil directly in the semi-liquid insulating compound in an air-tight receptacle and exhausting the air. The theory is that the insulating compound, or varnish, will be driven into the spaces as desired when a sufficiently perfect vacuum has been reached. While this process produces great improvement in the insulation and dielectric properties

of the coil winding, it does not afford as certainly satisfactory results as the more elaborate process.

Naturally the exact composition of the compounds used for this purpose is considered a trade secret by the various manufacturers but the desirable qualities in such a compound are very well known. The insulating compound should be moisture and oil-proof. It should be a fair conductor of heat, and it should not be chemically active. It should also be fairly strong mechanically when it has cooled so that all the wires in the coil will be imbedded, as nearly as possible, in a solid mass and will be forced to remain in their proper position.

319. *Examples of impregnated coils.*—Owing to the somewhat diverse methods used by various manufacturers, the term impregnation, when applied to coil windings, is somewhat indefinite. The most familiar examples of impregnated coils in telephone apparatus are: Transformer coils for some frequency system battery ringing converters; certain ringer coils; certain very exactly made repeating coils, signaling induction coils for telephone sets designed to work over ordinary Morse telegraph circuits; and induction coils designed for the ignition of internal combustion motors.

320. *Strains on insulation between adjacent turns of a coil.*—The entire matter, as it is of interest to the telephone man, may be briefly summarized as follows: In *every* coil carrying electric current, certain strains are set up in the insulation between adjacent turns. It is evident that this strain will be much greater between adjacent turns which happen to lie at the insulated end of adjacent layers. Now these strains, acting upon the insulation, are dependent upon the difference of electrical potential existing between the turns in question. The electrical pressure, on the other hand, between such turns is directly proportional to the total voltage impressed upon the coil and the length of the wire in the winding and is inversely proportional to the number of layers in the winding.

If the winding is made of short length and the number of layers is few, the pressure between adjacent turns, and therefore the strain on the insulation, will be lower than it would be if the wire in the coil were long and the number of turns greater. The practical effect of this law is this: Coils are wound in the form of *separate coils* or *layers* which are connected to form one complete unit, so far as electrical effect is concerned.

In other words, the insertion of paper, oiled linen, or insulating varnish between the layers of the winding, constitutes, in effect, the winding of separate coils and in this way the strain on the insulation between adjacent turns is kept at the lowest possible figure. The use of impregnation or insulating compound still further increases the value of the insulation between the adjacent turns as well as between the winding and the frame.

321. *Machine-wound coils and their advantages.*—The matter of automatically winding the great number of small coils required in the manufacture of telephone apparatus has always offered a very attractive field to inventors. The ordinary method of winding coils by hand on winding lathes, is somewhat expensive, comparatively speaking, and in some ways the hand-wound product is apt to be inferior to the best machine-wound.

Machine-wound coils, made under the same winding specifications, are more nearly uniform in the number of turns and in the resistance. This is a direct result of their manufacture by means of automatic equipment. In the finished coil, as produced automatically, the insulating wrapping of the wire has not been subjected to uneven pressure likely to impair it during its passage under tension through the grasp of an attendant. Owing to this and also to the fact that supplementary insulation in the way of mechanical binders is very likely to have been incorporated in the coil, it is generally true that the insulation of the machine-wound coil is superior to that of the hand-wound.

322. *Greater efficiency of hand-wound coils.*—To the operating telephone company it might appear that machine-wound coils would be desirable on account of their uniformity. The average coil of this kind, however, is not as efficient as a *properly* made hand-wound coil. This is due to the relatively greater amount of electrically idle material required by most methods, for the purpose of binding or securing the turns of the wire in their proper place.

323. *Description of one automatic winding process.*—In one of the most interesting automatic processes for winding coils, the wire is wound on the bobbin as usual, being fed automatically from the supply spool. While one part of the machine is feeding the wire, another part is feeding a thread. The wire is fed from end to end of the bobbin, and at the same time the thread is fed from end to end much faster than the wire. The final effect is an interweaving of the thread with the wire, sometimes above and sometimes underneath, until the necessary number of turns of wire has been wound.

In the finished coil, the ends are self-supporting and are solidly formed with the wire and binder securely laced into one mechanically solid mass of wire and thread. The ordinary binders' cloth, found on the outside of coil windings, is not, properly speaking, insulation at all. It is used as a finish to the winding and affords some slight mechanical protection to the wire. *(To be Continued.)*

Southern Michigan Company Reduces Toll Rate.

The Southern Michigan Telephone Co., of Burr Oak, Mich., has announced a reduction in rates on toll service between Three Rivers, Jones, Centerville and Constantine, to five cents. It also offers a flat rate of 25 cents per month additional to the regular telephone rental charge for the same towns. Forty-eight telephones have recently been added to the Three Rivers exchange.

Chicago Telephone Co. to Build Exchange in Geneva, Ill.

The Chicago Telephone Co. has purchased a site on the corner of First and Campbell streets, Geneva, Ill., upon which it expects to erect, in the near future, a new two-story exchange building to take care of its subscribers in St. Charles, Batavia and Geneva. The lot is 75 by 100 feet and the new exchange to be erected thereon will cost in the neighborhood of $20,000.

Employes at Owensboro, Ky., Receive Service Buttons.

C. B. Jacobs, district manager of the Cumberland Telephone & Telegraph Co., at Owensboro, Ky., made quite a ceremony about distributing among the employes of the company the service pins and buttons. Nine of the employes of the local exchange received five-year buttons; five of them received ten-year buttons and three were awarded fifteen-year buttons.

Digest of Telephone Articles in Various Publications

Prepared by Arthur Bessey Smith

WIRE AND WIRELESS TELEPHONY ADVANCES, by J. M. F. Wilson. The Electrical News (Toronto, Canada), Volume 24, No. 24, December 15, 1915; pages 16-18, two figures and three circuit drawings.

The writer draws attention to the recent attainment of telephone transmission of nearly 5,000 miles, and attributes it to loading and repeaters. Loading, he says, was the outcome of Heaviside's mathematics in 1885. He gives a brief description of the Brown relay, which repeats and amplifies conversation current by means of a microscopic arc inside a drop of oil. Considerable space is devoted to the principles of wireless telephony, concluding with references to the audion.

DEVELOPMENT IN RADIO TELEGRAPHY AND TELEPHONY DURING 1915, by Lee de Forest. The Electrician (London), December 31, 1915; page 466.

The writer of the review calls attention to the success of commercial installations, and the efficiency of the Poulson arc transmitter. Frequency doublers by means of asymetric transformers, the umbrella and triangular flat-top antenna, continuous wave transmission, and the ultra-audion have proven their permanent value. A brief description is given of the principles of the generation and detection of the waves used in the long distance telephony from the Arlington naval station to Honolulu.

HOW A TRANSMISSION COMPANY PREVENTED TELEPHONE TROUBLES, by F. Maury Gillespie. Electrical World, Volume 66, No. 24, December 11, 1915; pages 1315-1316, two diagrams.

Beginning with a fair but not good telephone service with the telephone line less than three feet from a 2,200-volt power line for twelve miles, the writer tells how by lowering the telephone line to a point four feet below the power line, installing horn gap arresters, knurled cylinder arresters, heavy drainage coils, and insulating transformers, as well as carefully transposing both lines, the telephone line was usable even when the line voltage was raised to 22,000 volts.

IMPERFECTIONS IN TELEPHONE RECEIVERS. Electricity (London), December 3, 1915; page 691.

The chief imperfections of the telephone receiver are capacity, impedance and hysteresis. After neglecting the first of these, the writer proposes the lamination of the poles, and the construction of forms of receivers which contain no iron, such as the condenser receiver or some form of thermal receiver. The whole is an interesting presentation of problems which are recognized by telephone engineers.

STANDARDIZATION OF LOADED TELEPHONE LINES, by Dr. F. Breisig. Abstracted in The Electrician (London), December 31, 1915, page 468, from complete article in Elektrotechnische Zeitschrift, Volume 36, page 297.

On account of the proximity of many international boundaries and the differences in engineering between the countries, the need is felt for care in the loading of lines so that they may be joined for long distance conversations with the least possible loss. The writer neglects the attenuation, but lays stress upon the characteristic and the distortion. In the spacing of loading coils, where the German rule places 100 coils, the English rule puts 79 and the American rule 87.5. A short mathematical treatment of the effect of frequency upon leakance and the effective resistance of coils closes the abstract.

DIE TELEPHONIE IM JAHRE, 1915 (Telephony in the year 1915), Helios, Year 21, Number 51, December 19, 1915, pages 610-611.

This is a very brief review (concluding previous writing) of the progress of the art of telephony. Methods for the calculation of the constants of telephone lines are discussed, and comparisons made between calculated and experimentally determined results. The Vienna exchange is cited as using automatic line-selecting switches for those subscribers who have several lines, only one of which is listed. American transcontinental telephony receives attention, also the long distance cable from Berlin to Rheinland, upon which Germany has expended liberally. After mentioning the Turkish telephone conditions, a good general idea is given of the nature of the telephone network employed in the present war.

GOVERNMENT OWNERSHIP. The Telegraph and Telephone Journal (London), Volume 2, No. 16, January, 1916; pages 67-68 and page 78, two tables.

In an article and an editorial, the anti-government ownership utterances of Theodore N. Vail and Mr. Carter (of the Hongkong section Institution of Electrical Engineers) are discussed and opposed. The writer boldly raises the question as to whether or not a government telephone system ought to be expected to pay its way, suggesting that perhaps its aid to commerce and public safety warrant its continuance even at a loss. Mr. Vail's figures are corrected, and further explanations made regarding operating expenses of the British post office. The service is claimed to be good, and as evidence there is shown average answering times from 5.1 to 6.0 seconds with from 80.7 per cent. to 91.9 per cent. of the calls answered in ten seconds.

The editorial lays great stress upon the need which the state has for controlling its communications, whether by rail, telephone or telegraph.

THE DAWN OF TELEPHONY IN BIRMINGHAM, by Arthur E. Cotterell. The Telegraph and Telephone Journal (London), Volume 2, No. 16, January, 1916; pages 69-71, two illustrations.

Though filled with reminiscences of a local nature most appreciated by our English cousins, there are several notes of interest to us. The first superposed circuits in the Birmingham district were used in 1892 to satisfy the complaints of two doctors who objected bitterly to the cross talk caused by their parallel, single-wire lines. Though the general idea of the time was to use balanced resistances, the author made one line metallic and worked the other as a ground phantom by means of repeating (translator) coils.

The electrophone demonstrations were very popular, transmitting the performances from the theaters in London. At one time several musicians in different towns played together by telephone, being directed by a pianist, and the music delivered to sixteen receivers. The writer describes the progress of centralization of offices, only to be later followed by decentralization.

THE TRANSMISSION OF TELEGRAMS BY TELEPHONE, by H. J. E. Still. The Telegraph and Telephone Journal (London), Volume 2, No. 16, January, 1916, pages 71-72.

The writer discusses somewhat in detail the question of a more wide use of the telephone in place of the telegraph for the transmission of regular written messages. Assuming that the telephone lines between any two centers are sufficient to carry easily and without delay the telephone traffic during the busy hours, it should, in normal circumstances, and at other than the busiest centers, be practicable to deal with all commercial telegrams by telephone during the remainder of the day and night.

At present the telegraph has greater flexibility than the telephone when it comes to superposing circuits, but the balance may be turned in favor of the telephone when engineers introduce a better method of superposing telephone circuits on each other so as not to be affected by the weather, and such as to be applicable to circuits irrespective of their lengths. Efficiencies in the operating force are to be expected.

A Traffic Department in the Near East, by Florence J. Minter. The Telegraph and Telephone Journal (London), Volume 2, No. 16, January, 1916; pages 72-74, one map, one table and one diagram.

The writer, who had charge of the traffic of the Constantinople Telephone Co. before the war, gives her experiences organizing the operating force in that city of mixed nationalities and religions. She had to deal, not with a slowly growing system from a few hundred telephones, but with a multi-office plant, two offices being as large as 2,400 to 3,000 lines.

After treating of the rates and the equipment of the switchboards, the writer relates her experiences in breaking the customs of the country in order to get the system to work efficiently. In spite of this, there were more applicants than positions for operators. Service observation was almost impossible because of the inability of a native to apply himself for many hours on a duty in any way monotonous. When the war broke out, traffic dropped at once due to the fear of the people of military espionage.

Overhead Electric Light and Power Circuits; British Post Office Requirements for Prevention of Contact with Telegraphs. The Post Office Electrical Engineers' Journal, Volume 8, part 4, January, 1916; pages 309-318, 17 diagrams.

The Board of Trade classifies power circuits as follows: (1) Low pressure, under 250 volts; (2) medium pressure, 250 to 650 volts; (3) high pressure, 650 to 3,000 volts; (4) extra high pressure, exceeding 3,000 volts. The post office makes 650 volts the dividing line. Below this limit, crossing must be protected by: (1) Arranging the earthed power wires to act as guard wires, as in three-wire distribution; (2) independent guard wires; (3) supporting the power wires by earthed suspending wires; and (4) insulating the telegraph wires sufficiently. Cross-lacing (Fig. 6) is required to prevent crosses.

For systems above 650 volts, the protection of a crossing must be absolute, eliminating all risk of mechanical contact. This practically forces one of the lines to be put underground

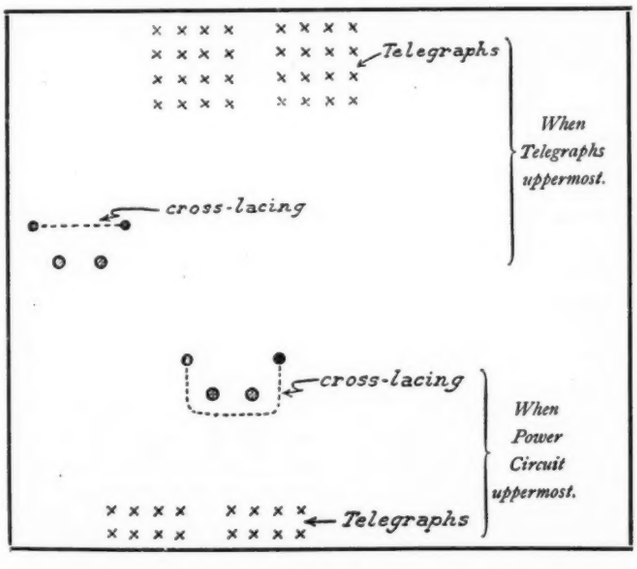


Fig. 6. Cross Lacing to Prevent Crosses.

at an actual crossing, and since the loss to telephone or telegraph transmission in cable is greater than to power transmission, the power lines must go underground.

Electrolysis and Its Mitigation, by E. B. Rosa and Burton McCullom. Technologic Paper No. 52, Bureau of Standards, Washington, D. C., December 27, 1915; 143 pages, 14 views, 8 tables, 7 plates of curves and 23 diagrams. (Superintendent of Documents, Washington, D. C., 30 cents.)

Though the United States Bureau of Standards has made an extensive study of the laws of electrolysis, and of the work of previous investigators, the work is incomplete. This report is confined to the prevention of electrolysis in metallic structures, such as gas and water systems and lead covered cables.

It appears that when stray current trouble appeared, Great Britain adopted stringent regulations for reducing the damage, forcing the railway tracks to be better bonded and to be pro-

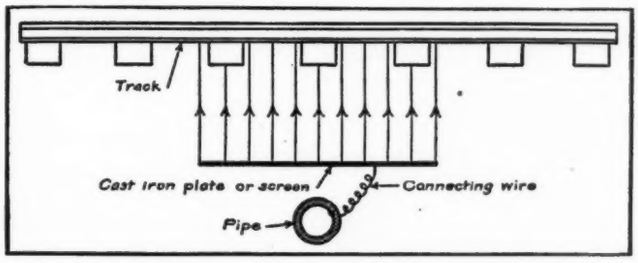


Fig. 9. The Plane Screen.

vided with return feeders. This mitigated the corrosion so that it has not been serious. Other European countries have treated the matter similarly, with good results. In America no such measures were taken, but the drainage system was employed by the company affected. The results have not been satisfactory.

After discussing self-corrosion and the other effects of stray currents beside corrosion, the bulletin gives the results of the investigations on surface insulation of pipes, chemical protection, cement coatings, cathodic protection, location of pipes with respect to tracks, conducting coatings, electric screens (Fig. 9), insulating joints in the pipes and pipe drainage (commonly known as bonding).

In conclusion, stress is placed upon the danger of attempting to avoid electrolysis by bonding (drainage) alone, and urges the reduction of potential drop along return rails to 0.3 or 0.4 volt per thousand feet (all day average) and an over all voltage drop of two to four volts. Potential drops on the pipes and cables themselves should be half these figures.

"Telephony's" Home Course for Telephone Men.

(Not meant for study.)

By Well Clay.

Spasm No. 2.

I leaned across the windowsill
To catch the cooling breeze;
The misty moon peered down at me
Through the network of the trees;
The sleepy stars looked down upon
A sleeping world below
When—athwart the silence of the night—
I heard a rooster crow.

Just like that! It probably was what woke me up, too, as the noise of a rooster's crowing is tangible and something we can understand whereas the rest was more or less but the tattered fabric of a dream, to use a "flossy," though somewhat unintelligible term. I am not afraid to do that now because I know that lots of telephone men are daily dealing with many phases of their business that are absolutely unintelligible to them.

This week I attended a "hearing" (don't confuse this with an "understanding") before the Minnesota Railroad & Warehouse Commission on the question of the adequacy of the remuneration for the handling of toll business by the small companies on the present "five cents in and out" basis. From the testimony, I judged that my oldtime friends, Supposition and Rumor, had not starved to death since I parted company with them, as I did finally. But, to get back to the rooster and continue my story:

A very tangible noise broke in upon us one day after we had been in business a year or two. This noise was caused by the concussion of one of our linemen, Haphazard—"Old

Hap," we called him—falling off a pole and breaking his leg. He was always doing something to put a "tack" in our financial tire. He had a side partner, Careless—the girls called him "Pretty," on account of his happy-go-lucky ways—who we had kept on the job because he worked cheaply. But when we had to call in old Damages, who was quite an expensive person, to take care of him, we made up our minds that they were too dear to have around at any price, so we decided to get rid of them.

As I was studying over the best way to get shut of them, who should come into the office but this same fellow who had been happening in and out before. He came in this time and took off his hat, which he hung on the rack, and acted as though he had come to stay. I had been speculating for some time as to the nature of his business and what name he went by, so I decided, as long as he was acting so familiar about the place, himself, that I would ask him.

He smiled a little at the question as to his name and said.

"You have met me many times before but never had time to stop and get acquainted, so I did not urge the matter. But I reckon you are going to be in a position to use me now and we might as well get started right.

"My name is Common Sense and I come from a very reliable family. My father, Careful Analysis, was from the family raised by that good old couple, Right Conception and Correct Estimate, and my mother was one of the girls raised by that worthy couple Intelligent Observation and Careful Study. Her name was Correct Deduction. Through both sides of the house, we are related from far back with those grand old patriarchs, Necessity and Experience. So you see I have a family reputation to maintain, as well as to merely get along in the world."

Well, we got to talking about the thing that was uppermost in my mind at the time, as was natural, and I asked Mr. Common Sense what he would do about the matter.

He said to go to a friend of his—by the way, he afterwards turned out to be a very zealous fellow for working in his friends on the job—by the name of Adequate Insurance, who would, for a reasonable fee, take care of such cases.

"But the expense?" I queried.

"You must provide for that in your charges to the Public, and so long as you have those undesirable fellows, Dollar a Month and Free Service, on the job, I know you have not done so."

"But how can I get things adjusted so that these extraordinary expenses are paid by the public?" I asked.

"Listen, my friend," said he, "I know a good party whom you should have working for you. Her name is More Revenue. She is not apt to be very popular at first with the patrons, but she does work wonders as a help to the business. But in order that she may have a chance to work properly, you must fire that old gang, Dollar a Month and Free Service, off the job."

I liked the sincerity of his talk but I sure did hate to dispense with the services of the two fellows, who had not only been a great help in building up the business but had become mighty popular with the patrons.

"Another thing you must do, if she is to accomplish what she is capable of and that is, you must let that girl, Poor Bookkeeping, go and hire her cousin, Good Bookkeeping, in her place."

I was beginning to dislike this Common Sense fellow because it looked as if he were merely trying to use his newfound influence to work in a job for a lot of his friends, which meant the losing of such jobs by some employes who had been with me from the first. Take for instance, Poor Bookkeeping—she was an easy-going girl and good natured, never getting too particular about anything and always ready to settle any differences with customers, by throwing off a part of the bill, thus keeping them good natured. One trouble with her was that she never could just show what had become of things and had only a vague idea of the business generally.

I was getting in deep and was desperate. I made up my mind that I was going to have some trouble in making the business swallow all this new crew in a bunch. I had an idea, though, it could be done, as I had seen a small snake attempt to swallow a frog, which was a sizable fellow and disinclined for the venture. But the snake won, though it left a very noticeable lump amidships for quite a while afterwards. The snake lived through it and looked more prosperous than ever, after the lump disappeared.

Mr. Common Sense said that Good Bookkeeping was really a relative of the Revenue family. While relatives usually didn't work together, harmoniously, for any length of time, here was a case where they were really inseparable. I couldn't help but see that he was right but, dog-gone his nerve, I had given him an inch and now I was needing a motorcycle to get in sight of him.

His next request took my breath away. He wanted me to introduce him to the board of directors. So I showed him the door and said I guessed I would try to worry along without him because his ideas would ruin the business anyhow and what use would there be for any of us then. He went away for the time being, hinting darkly of what would happen if I didn't use him in the business.

That night I called in the old boys and girls and we went over the matter together. I was much cheered at the end of the session as they had all expressed themselves in most optimistic terms and jollied me up wonderfully. They said not to *worry* as *everything* would come out all right *somehow*. They were so gay and careless that I caught the infection of their good spirits and dismissed the other guy from my mind until he turned up again unexpectedly later on one day under circumstances which were rather embarrassing for me.

(*To be Continued.*)

What relation is Poor Bookkeeping to Profits?
Why does it take Common Sense so long to get on the job?
Why cannot Insufficient Revenue and Big Dividends agree?
Is Common Sense a Stranger to your Exchange or Factory?
Is Education the mother of More Revenue?
Do the children of Experience always graduate with honor?
When an optimistic jolly meets up with an incontrovertible fact what happens?

(Keep it to Yourself)

Home Company of Parsons, Kan., Changes Ownership.

H. M. Evans, of Kansas City, Mo., has purchased the Citizens Home Telephone Co., which operates under franchises in Parsons, Pittsburg, Oswego, Chetopa, Bartlett, Altamont, Edna and Mound Valley. The basis for the sale of the holdings was made on a valuation of $126,000.

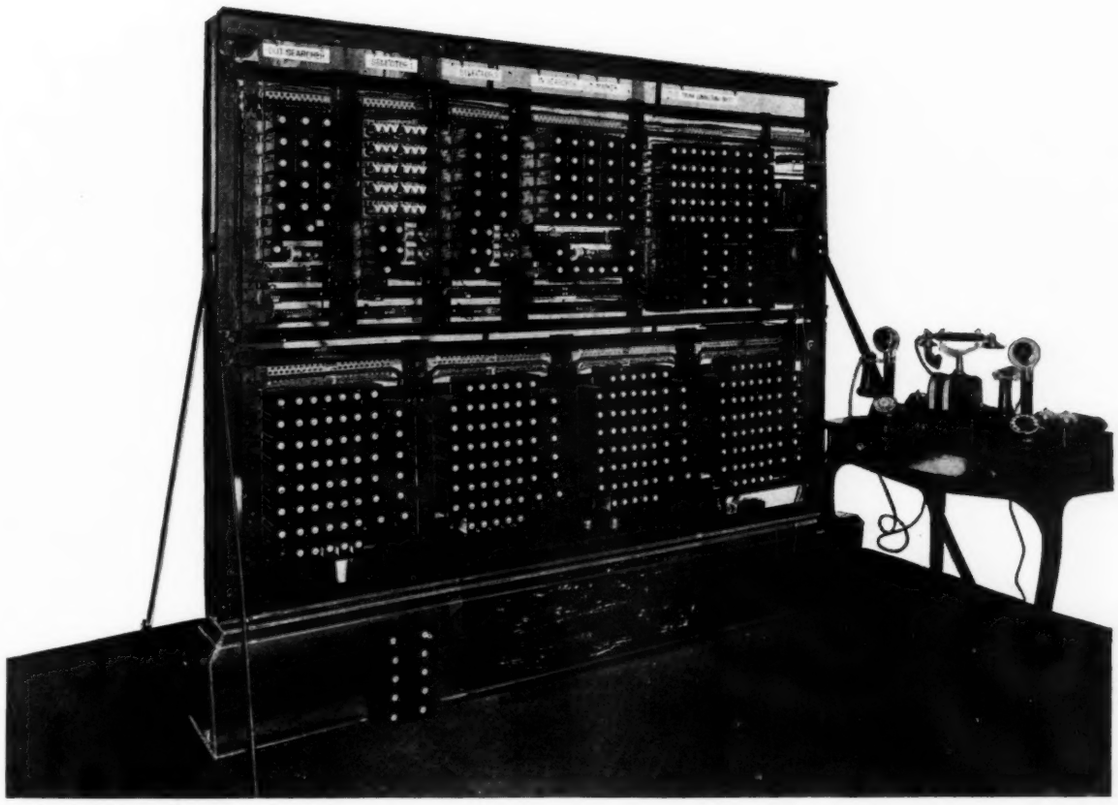
PERSONAL ITEMS FROM THE FIELD.

J. A. SCHOELL, secretary and treasurer of the Citizens Telephone Co., of Belle Plaine, Minn., was recently elected president of the State Bank of Belle Plaine, to succeed George A. DuToit, who has resigned from the office after 15 years of service.

WM. E. BOWERS, New Haven manager of the Home Telephone & Telegraph Co., of Fort Wayne, Ind., will be nominated as the Republican candidate for joint-senator for Allen and DeKalb counties at the March primaries as he has no opponents in the race.

DR. MICHAEL IDVORSKY PUPIN has been awarded the Hébert prize for physics by the French Academy of Science for his important service to telephony and telegraphy and his method of harmonic analysis. Dr. Pupin has turned over the prize, which was 1,000 francs (about $200), to a fund for women and children who have been made orphans by the present European war.

THE LATEST IN AUTOMATICS



A 4300 Mile Trip in War Time

This is a picture of the Switchboard that made the journey. The time was short; the packing was hurried; the material was hustled in and out of express cars, and bustled in and out of the steamship. We were anxious to see how it would come out.

The Damage

The total damage was two insulating studs broken. The repair cost but a few minutes' time, the material being too small to figure.

Moral

Relays Are Good Workers and Good Travelers.

Address in Care of **Marconi Wireless Telegraph Co. of America, Woolworth Bldg., New York**

Please tell the Advertiser you saw his Advertisement in TELEPHONY.

Obituary.

B. B. ANDREWS, manager of the Jamaica and Richmond Hill exchanges of the New York Telephone Co., died recently at his home in Jamaica at the age of 46 years.

DENNIS J. HERN, who was associated with Dr. Alexander Graham Bell in his first experiments with the telephone, and who was known to telegraphers the country over as "Denny Hern," died at his home in Boston, Mass., February 7. Mr. Hern was born in Boston in 1854 and began work at the age of ten as a messenger boy with the United States Telegraph Co. He gradually rose in authority to the superintendency of telegraph lines between Bangor, Maine, and New York City, and for ten years was general manager of the Mutual District Messenger Co., of Boston, also being associated with the Western Union company until 1902. Later he served as commissioner of health at the port of Boston and for a short time was in charge of the city lighting department. He leaves a widow and one son.

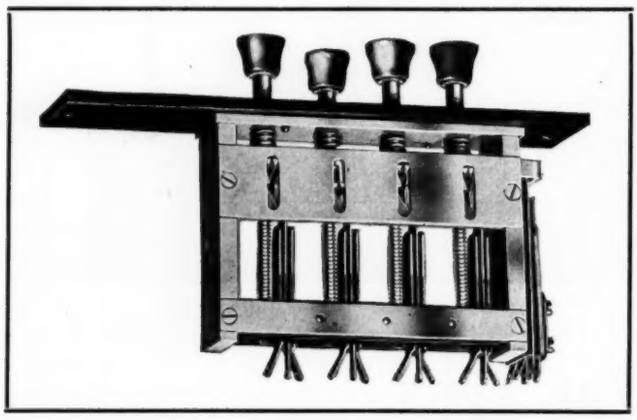
GEORGE S. SHANKLIN, president of the Fayette Home Telephone Co., of Lexington, Ky., passed away recently following an acute attack of heart trouble. Mr. Shanklin, who was 56 years of age, was just finishing some business details preparatory to leaving for a stay in Florida in the expectation of benefiting his health. He was stricken with an acute attack of heart trouble while dictating a letter and died immediately. In the movement for formation of the Fayette Home company, Mr. Shanklin was especially active and became president of the company on its incorporation. He was prominent in law, political and social affairs in Lexington and was a leading member of the city's vice commission.

From Factory and Salesroom

Conventions: Iowa, Des Moines, March 14-16; Texas, Fort Worth, March 16-18

Kellogg Company Perfects New Switchboard Key.

The Kellogg Switchboard & Supply Co. has recently perfected and is equipping all its switchboards with a new key. It has so many outstanding features of merit that a detailed description of them on these pages will be of interest.



The New Kellogg Four-Party Ringing Key.

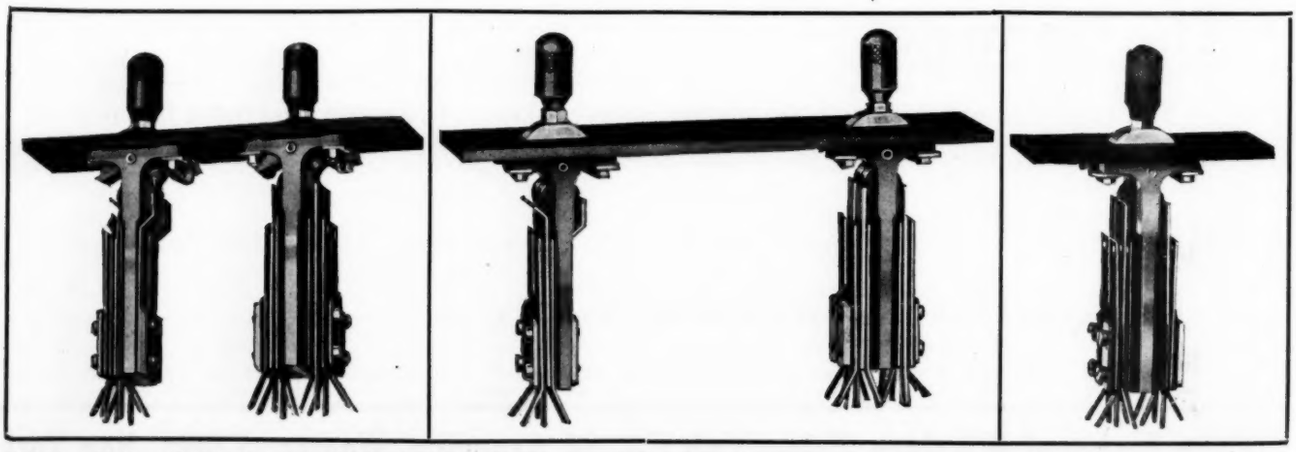
Every telephone man knows the importance of good key building—if he has had anything to do with switchboard maintenance. He knows that a good key is a sure trouble chaser. Experience tells him what is a good, reliable key.

The Kellogg key has long flexible German silver springs, with very short action, which, it is contended, reduces spring breakage to a minimum. This short action also reduces the wear on the rollers and the cam. The insulating material used is Bakelite and micarta. The tube bushings, which extend through the spring assembly, are made of Bakelite. This is claimed to entirely eliminate burnouts and carbonization common to rubber insulations. The separators between the springs are extra heavy and constructed in such a manner that dust will not accumulate between the springs.

To keep the springs in line a projection has been cast on the main Bakelite insulator projecting between the springs in such a manner as to always keep them in perfect alignment. Troublesome head bushings are said to have been entirely done away with; heavy metal clamps are used under the mounting screw heads, making a very secure fastening.

The "T" frame permits the contact springs to be mounted on both sides, thereby increasing key combinations, and at the same time balancing the strain. The cam is so designed that the rollers are held in place on steel bearings without the use of screws or rivets. The main steel cam bearing is much wider than commonly used, and does not have the ordinary side play.

Stops are provided, which make it possible to obtain either the locking or unlocking movement by merely rearranging the springs and stops. A special stud is used to



The New Kellogg Switchboard Key—Two Types of Combined Listening, Ringing and Ring Back Keys and a Ringing and Ring Back Key.

ERICSSON STEEL TELEPHONES

Five Reasons Why You Should Use Them

1st — They are the handsomest telephones made, and subscribers are pleased with them and take pride in keeping them neat. They put a stop to chronic kickers.

2nd — They are built to last almost indefinitely. The black enamel finish will outlast any known wood polish and will match any color of woodwork or inside finish.

3rd — They cost no more than reliable telephones of other makes, and are worth considerably more to you. They do not deteriorate and they save you the heavy maintenance expense you have been accustomed to with others.

4th — They are made by a manufacturer with a reputation for making the best telephone apparatus known. Their guarantee makes you safe.

5th — You will be using Steel Telephones altogether some day, so why not begin now. The sooner you get acquainted with the Ericsson kind the better pleased you will be later.

BRANCHES AT

Atlanta, Ga., 83 Marietta St.
Birmingham, Ala.
Boston, Mass., 451 Atlantic Avenue.
Butte, Mont., 53 East Broadway.
Cedar Rapids, Iowa, 315 So. Second St.
Chicago, Ill., 14 N. Franklin St.
Cleveland, O., 124 St. Clair Ave., N. E.
Edmonton, Alta, Can., 504 Agency Bldg.
Havana, Cuba, P. O. Box 6.
Indianapolis, Ind., 124 So. Meridian St.
Jacksonville, Fla., 24 W. Forsythe St.
Lincoln, Neb., 136 So. 10th St.
Los Angeles, Cal., 1233 So. Olive St.
Louisville, Ky., 514 W. Main St.
Minneapolis, Minn., 19 N. 6th St.
New Orleans, La., 810 Canal St.
Pittsburgh, Pa., 31 Terminal Bldg.
Portland, Ore., 329 Ankeny Ave.
Richmond, Va., 5 Governor St.
San Francisco, Cal., 530 Golden Gate Ave.
Spokane, Wash., Paulsen Bldg.
Toronto, Canada, 36 Adelaide St.

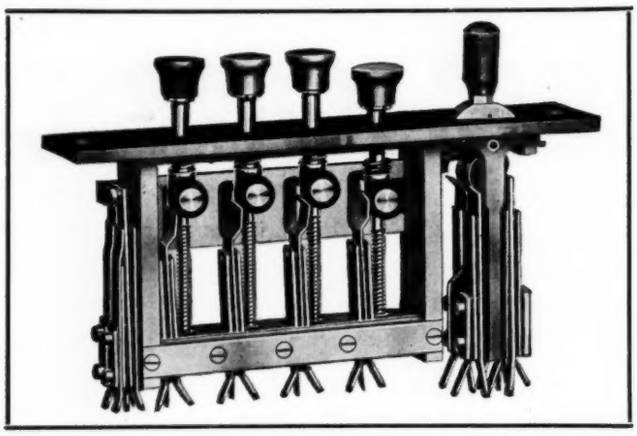
ERICSSON MFG. COMPANY

1102 MILITARY ROAD :: :: BUFFALO, N. Y.

mount the cam handle, which greatly increases the strength of this particular part.

The principal advantages of the Kellogg cam type key are given as follows:

1. Long flexible German silver springs of the proper



The New Kellogg Four-Party Ringing Key and Listening Key.

thickness and tension with short action, reducing spring breakage and wear on the cam and roller to a minimum.

2. Bakelite insulating material used throughout.

3. Tube bushings are of the headless type.

4. The Bakelite separators between the springs are extra heavy and of such design that foreign substances, such as dust, etc., cannot remain between the springs.

5. A projection has been cast on the main Bakelite insulator which rests between the springs and the key frame in such a manner as to always keep the spring assembly in perfect alignment.

6. Heavy metal clamps are used under the mounting screw heads.

7. The "T" frame permits the contact springs to be mounted on both sides, thereby increasing possible spring combinations and at the same time balancing the strain under all conditions.

8. The cam is so designed that the extra heavy rollers are held in place without the use of screws or rivets.

9. Large bearings are provided for the rollers.

10. Extra wide, heavy steel bearings are furnished for the cam, eliminating side play.

11. A special stud is used to mount the cam handles, which greatly increases the strength of this particular part.

12. The general construction of the cam type key is such that only one frame and one cam, together with the universal stop, is necessary for any combination of key that is desired, making it possible to change this key to any combination by merely changing the springs and rearranging the stops.

13. The frame and cam are constructed of drawn brass.

14. The studs and screws are of steel.

Stromberg Toll Board for Wabash, Ind.

The Home Telephone Co., of Wabash, Ind., has placed an order with the Stromberg-Carlson Telephone Mfg. Co., of Rochester, N. Y., for a four-position drop signal multiple toll switchboard to take care of its rapidly increasing long distance business.

The equipment is now under construction and as soon as it is completed more complete equipment details will be given in these columns.

Exhibit of S-R Electric Co. at Wisconsin Convention.

The demonstration of the S-R private service system for rural party lines at the convention of the Wisconsin State Telephone Association last week, created a great deal of favorable comment. An instance of the interest was the culmination into a proposition for the S-R Electric Co., of Chicago, manufacturers of the device, to send a representative to a town in Wisconsin close to the homes of three telephone companies, and there install S-R private service attachments to the telephone instruments, belonging to these companies, in a room furnished by the mayor of the town in the city hall. After installing and testing out the device thoroughly, the companies assert they will arrange to install 2,000 S-R private service attachments on their several party lines.

Another feature of S-R Electric Co.'s exhibit was the battery cut-out or battery saver. The S-R battery cut-out can be attached to any local battery telephone instrument, in a few minutes, by anyone at all familiar with the local battery telephone, without taking the instrument from the wall.

K & B Telephone Holders and Accessories.

The K & B Co., 25 No. Seventh Street, Philadelphia, Pa., has just issued a revised edition of its catalog of telephone holders and accessories. In it are described and illustrated telephone holders for practically every use and adaptable to almost any position, as well as handy telephone indexes, pads, silencers, antiseptic mouthpieces, telephone booths, booth fans and other telephone accessories.

The company is desirous of getting in touch with persons who will act as agents for its telephone specialties. By making a specialty of this class of material, the company states, it is in position to handle it on a wholesale basis to agents, electrical supply houses, hardware dealers, etc., as well as taking care of consumers' business.

History of Copper Wire as Told in Prices.

The Rome Wire Co., of Rome, N. Y., has issued its annual copper history folder giving the monthly average prices of copper from the year 1885 to 1916. Those interested in

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly Average
	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Cts.	Dollars
1885	11¾	11¾	11	11	11½	11⅝	11¼	11¼	11¼	11	11	11¼	.11166
1886	11⅛	11⅛	11⅛	11⅛	10⅞	10¼	10⅛	10⅜	10⅜	11⅜	12	12	.111458
1887	11⅝	11	10⅜	10⅛	10	10	10⅜	10⅜	10⅛	10½	12⅝	17	.11323
1888	16½	16⅜	16	16⅜	16⅜	16½	16⅜	16⅜	17¼	17¼	17½	17¼	.16781
1889	17⅛	16⅜	16½	16⅛	12½	12¼	12	12	11½	11	12½	14⅛	.137395
1890	14½	14¼	14¼	14½	15	16¼	17	17	17	17	17	16	.15812
1891	15	15	14	14	13¼	13	13	12⅜	12½	12¼	11½	11	.13093
1892	11	10⅜	11¼	11⅜	12	12	11⅜	11⅜	11¼	11⅜	12	12¼	.11625
1893	12⅛	12	11⅞	11⅛	11	10⅜	10⅜	9⅜	9⅜	9⅜	10	10⅜	.10781
1894	10	9⅜	9⅜	9¼	9⅜	9¼	9¼	9¼	9¼	9⅜	9½	9⅜	.095416
1895	10	9⅜	9⅜	9⅜	10½	10⅜	11⅜	12	12	12	11⅜	10⅜	.10812
1896	10	10⅜	11	10⅞	11¼	11⅜	11¼	11	10⅜	10⅜	11⅜	13⅜	.10979
1897	11⅜	12	11⅜	11⅛	11	11¼	11⅜	11¼	11¼	11¼	10⅜	11	.11333
1898	11¼	11⅜	12	12	12	11⅞	11⅜	12	12⅜	12½	12⅜	13	.12062
1899	15	18	18	18⅜	18½	18¼	18½	18½	18½	18	17⅜	16⅜	.17802
1900	16½	16¼	16⅜	17	16⅜	16¼	16½	16⅜	16⅜	16⅜	16⅞	17	.16656
1901	16⅜	17	17	17	17	17	17	16⅜	16⅜	16⅜	16⅜	14⅞	.16729
1902	11⅜	12⅜	12⅜	12¼	12⅜	12½	12¼	12	12	11⅜	11⅜	11⅜	.12135
1903	12¼	13¼	14⅜	15¼	15	14⅜	13⅜	13⅜	13⅜	13⅜	13¼	12½	.13791
1904	12⅜	12½	12⅜	13⅜	13¼	12⅜	12⅜	12⅜	12⅜	13⅜	14⅜	15¼	.1325
1905	15½	15¼	15¼	15⅜	15¼	15¼	15¼	16	16⅜	16⅜	17¼	19	.16093
1906	19⅜	18½	18⅜	18⅜	18⅞	18⅜	18⅜	18⅜	19½	22	22⅜	23½	.19812
1907	25¼	25⅜	26	26	26	26	23	18½	16½	13⅜	13⅜	13⅜	.21177
1908	14	13¼	13	13	13	13	13	13⅜	13⅜	13⅜	14½	14½	.1354
1909	14⅜	13¼	12⅜	13	13¼	13½	13½	13½	13¼	13¼	13⅜	13⅜	.1342
1910	13⅜	13⅜	13⅜	13¼	13	12⅜	12⅜	12⅜	12⅜	12⅜	13	13	.13135
1911	12⅜	12⅜	12½	12½	12⅜	12⅜	12⅜	12⅜	12⅜	12⅜	12⅜	13⅜	.1275
1912	14¼	14¼	15	16	16⅜	17¼	17⅜	17⅜	17⅜	17⅜	17⅜	17⅜	.16708
1913	17	15¼	15¼	15⅜	15⅜	15⅜	14⅜	15⅜	16⅜	16⅜	16¼	15	.15833
1914	14⅜	15½	15	14⅜	14⅜	14⅜	14½	13	12⅜	12¼	13¼	13½	.13906
1915	14⅜	15¼	15⅜	18½	22½	22½	22¼	19½	18½	18¼	19⅜	30⅜	.189375

Monthly Average Price of Copper from 1884 to 1916.

the purchase of copper wire will find this folder of value. The company will be pleased to furnish copies of it to persons who may be interested, upon request.

Paragraphs.

THE HOLTZER-CABOT ELECTRIC CO. is sending out announcements to its patrons and friends inviting their inspection of its new building at 125 Armory street, Boston, Mass., Roxbury district on Tuesday, February 22, from 10 a. m. until 4 p. m.